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CONFERENCE NUMBER

THE

TEA QUARTERLY

THE JOURNAL

OF THE

TEA RESEARCH INSTITUTE

OF CEYLON

THE TEA RESEARCH INSTITUTE,
St. Coombs, Talawakelle,
Ceylon.

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General.—The laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and all letters and enquiries should be addressed to the Director, Tea Research Institute, Talawakelle. Telegraphic address : RESEARCH, TALAWAKELLE, Telephone : Talawakelle 44 (Private Exchange).

It is particularly requested that letters should not be addressed to officers by name. Specimens and other consignments sent by rail should be forwarded to Talawakelle Station, C/o Messrs. M. Y. Hemachandra & Co. Ltd. Forwarding Agents. *Carriage should be pre-paid.*

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Publications.—The *Tea Quarterly* and *Bulletin* published by the Tea Research Institute will be sent free of charge, to Superintendents of Ceylon tea estates, over 10 acres in extent, and to estate Agencies dealing with Ceylon tea, if they register their names with the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle.

Other persons can obtain the publications of the Institute on application to the Director, the subscription being Rupees fifteen per annum for persons resident in Ceylon or India, and £ 1–5–0 for those resident elsewhere. Single members of *The Tea Quarterly* can be obtained for Rs. 2–50 or 4*s*. In the case of Indian cheques four annas should be added to cover commission.

THE TEA QUARTERLY

Conference Number

VOLUME XXIV JUNE, 1953 PARTS I & II

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CONFERENCE — PROCEEDINGS

OPENING ADDRESS BY R. C. SCOTT, Esq., C.B.E.

CHAIRMAN, TEA RESEARCH INSTITUTE

Before commencing this tenth Conference of the Tea Research Institute of Ceylon, inaugurated 27 years ago, I would like to extend a very cordial welcome to the scientists and others representing commercial and planting interests who are present today.

We have with us this morning Mr. de Jong of the United Planters' Association of Southern India ; Dr. W. J. Dowson, a former director of the departments of Pathology and Mycology at the School of Botany at Cambridge, who has come out here, at the invitation of the Board, to assist in our research especially in the mycological department of the Institute.

Mr. S. J. Wright, whom some of you already know, is here under the Colombo Plan to see what can be done to assist the tea industry in mechanisation on estates in the future.

Also a representative from an important tea interest in the United Kingdom, managers of various companies in Ceylon, reprsentatives of agency houses and commercial firms. I extend to everyone of them a cordial welcome and sincerely hope that you will be interested in the proceedings that follow.

I now extend a special welcome to the Hon'ble the Minister for Agriculture and Food, Sir Oliver Goonetilleke, K.C.M.G., K.B.E., I am so pleased that you, Sir, have been able to accept our invitation to open this Conference, and I now ask you to deliver your address which I am sure all present will listen to with great interest.

ADDRESS BY THE HONOURABLE SIR OLIVER GOONETILLEKE, K.C.M.G., K.B.E.

MINISTER OF AGRICULTURE & FOOD

Mr. Chairman, Ladies and Gentlemen,

It is needless to say how very great a privilege it is for me, and for that matter for any Minister of Agriculture, to be given this opportunity of participating in this special way in the proceedings of T. R. I. Conferences.

Within the very limited time at my disposal I would like to draw the attention of those present to some of the problems, which appear to me, as Minister, to be facing the tea industry. I know you will all forgive me if, in the course of doing so, I refer to some of your very great achievements. I do not think that, generally speaking, those engaged in the industry, be it in the capacity of investor, superintendent, or labourer, realise how much the tea industry means to the economy of our Island.

In 1951 the quantity of tea exported amounted to 305,000,000 lbs. In 1952, the amount rose to 314,000,000 lbs. The value of exports in 1951 amounted to Rs. 800,000,000; in 1952 to Rs. 723,000,000. In 1951 the exports amounted to 44% of our total exports; in 1952 they amounted to 52% of our total exports. The export duty on tea in 1951 amounted to 55% of the total export duties collected. In 1952, the export duty on tea amounted to 60% of the total export duties collected.

If you take the ratio of tea export duty to the total of both import and export duties in 1951, it represented 29%, and in 1952 25%. I wish to complete the picture by inviting not only the attention of this Conference, but also of the public outside, to the fact that the tea industry in the assessment year 1951/52 contributed no less a sum than Rs. 61,000,000 as income tax and profits tax. This figure does not, of course, include the amount paid by agency houses, brokers, and the personal income tax payments of the managerial staff.

I think the figures are convincing enough to satisfy not only you, but all right thinking persons in Ceylon, that there is no single factor in our economy which has a greater bearing on our future than the tea industry.

I think it is of importance to consider the long term problems and I should like to place before this Conference some of the figures of production in the decade following 1939.

Undivided India, for example, in 1939 produced 467,000,000 lbs. of tea. In 1951, India and Pakistan together produced 674,000,000 lbs. of tea. Portuguese East Africa has increased its tea acreage from 6000 acres to 24,850 acres. British East Africa is showing a steady expansion in her planting and today there are 60,000 acres of tea in British East Africa. It is reported that the Government of

Australia is actively extending the acreage of tea in New Guinea. I think it is clear whatever the short term prospects may be, the long term prospect for tea is a very real competetive struggle.

In regard to the short term prospects, one notices with a certain amount of satisfaction that production in 1952 was much higher than in 1951. That brings me to a very important discussion, the final stages of which are taking place this very day in London. It was not unexpected that in the course of the discussion now proceeding in London under the International Tea Agreement, there should be a demand for the restriction of production in the next Control Year. You know that Ceylon's export quota for the current Control Year has been fixed at 135% of our standard production. The figures to date indicate very clearly that in the Control Year now ending, we should export a little more than 125% of our standard production. Therefore, any attempt to reduce the 135% to 125% will have to be resisted by the Government. During the forthcoming year it is not unlikely that we should approximate to a figure near 130%.

While we are not unmindful of the problems of countries that over the last two years have increased their production more than they should have by coarse plucking, I sincerely believe that this is the wrong time to face the tea consumers of the world with any apparent or real threat of restriction of production.

As you know, the Ceylon tea industry and, for that matter, tea industries all over the world have only one safe guide and that is—the consumers of tea are always right. We have to produce a commodity that the consumer is prepared to buy at *his* price. It is no use trying to save the tea industry by restriction of production. It is true that under the International Tea Agreement we have limited ourselves and other countries which participated in this Agreement in regard to future planting. We have, however, reached the limit, and whatever may be the difficulties of production in the tea industries either in short-term or long-term, I think this Conference would agree that the attitude your Government is taking in London today is in the best interests not only of Ceylon but of the whole industry.

Mr. Chairman, I must pass very quickly over the remaining points. What is the future problem facing us ? The problem is to maintain the quality of our tea and to reduce the cost of its production and, when you realize that in the last factor is included all that your soil needs in the way of manuring and the expenses involved in fighting pests and diseases, you know how difficult it is to keep down costs of production. But these are inevitable problems of agriculture, and the romantic story of the Tea Research Institute is full of instances where you have overcome these difficulties.

It is not possible for a Minister to appear at your Conference and not to refer to the successful battle that the Institute waged against the tea tortrix with the introduction of the long tail parasite in 1938. Again, in 1949, I think there were very gloomy faces at a conference like this when blister blight appeared to be unsurmountable. Today, thanks to the unremitting vigilance and ever ready guidance of the Tea Research Institute, I think the tea industry can talk of another major victory over a difficult problem.

I want now to say one word in regard to the inevitable necessity for maintaining the fertility of your soil. I think it is a matter for congratulation that the tea fields of Ceylon consumed in 1950 no less an amount than 52,000 tons of ammonium sulphate and 27,000 tons of rock phosphate. I would like to compare these figures with the figures for 1939—35,000 tons of ammonium sulphate and 11,000 tons of rock phosphate.

I would like to bring to your notice and that of the visiting scientists here that probably the tea fields of Ceylon represent the most highly manured agricultural lands anywhere in the world. The problem that faces the fertility maintenance of the tea fields has not ended. All of you will be thinking of the soil erosion that still takes place in this part of the Island. Very soon regulations under the Soil Conservation Act will be published. We wish to bring under control of these regulations the 500 square miles of the upper catchment of the Mahaweli and Kelani Gangas, and I would plead today for the largest possible measure of collaboration in the operation of the Soil Conservation Act. I have already given general instructions to those who will operate this act that the one thing they must not attempt to do is to "try to teach their grandmothers to suck eggs". I am fully conscious of the fact that there are fields today in Ceylon that have been continuously cultivated for nearly 100 years, and still preserve their fertility. There must be a great deal in the grandmother's style of sucking eggs.

Conferences like this would not be complete if no reference was made to the outstanding leadership that the planting industry of Ceylon has always brought forward. Today you meet without the presence of one person to whom this Research Institute owes a great deal. Robert Gordon Coombe is no more, but I think his monument may be in this room. In 1923, it was his resolution that brought about the starting of the Tea Research Institute and for nearly ten years he was its Chairman. There are other names that ought to be mentioned by a Minister on an occasion like this—Mr. Petch, Dr. Norris and two other stalwarts who, I do not think, are present here—J. W. Oldfield and T. Y. Wright. The hand of the old leadership is, however, still guiding the ship. You, Sir, for nearly a decade have been Chairman of this Institute. My personal acquaintance with your leadership started not with regard to matters pertaining to the tea industry. There cannot be many in this room who will not always remember the high standard of service you set in the last world war, with special reference to the service you rendered in connection with the convalescent home at 'Ottery', your own home.

I think I have said enough to emphasise that your leadership in matters pertaining to the tea industry is worthwhile. Your difficulties cannot be separated from difficulties of government. You have to control labour and depend on the efficiency of labour. There are, however, in this room many old soldiers although there is probably a larger percentage of new arrivals than was the case last year or the year before. For the benefit of the new arrivals I would say that Ceylon is the best job that the British have done anywhere in the world. You see what is happening in other lands. Your difficulties are trivial compared to what men like you have to face in other countries outside their own land. Therefore, if you and your government and everybody who lends a hand in the furtherance of the tea industry bear in mind that the future of this land is intensely involved in your doing the right thing, I am certain that the future, not only of the tea industry, but of Ceylon is assured. I thank you.

Chairman : On behalf of myself and all assembled I thank you most sincerely, Sir Oliver, for your most illuminating address. You have shown a very intimate knowledge of all that concerns the tea industry both in its commercial and political aspects, and it is most gratifying to know that a Minister whose lot it is to control our destiny, and that of the Tea Research Institute, has such an intimate knowledge of all that is transpiring in the industry. I will not allude to the many details touched upon in your address, but I am pleased indeed that you have stressed the necessity for Ceylon to preserve the quality of its teas. In this connection I can only express the hope that all concerned will do everything possible to maintain the standard of Ceylon teas, particularly in view of the steady rise in costs that has been inevitable in recent years.

As Chairman of the Institute I am very appreciative of the tribute you have paid to past officers of the Institute and also to the present staff, and I am glad indeed that you should have mentioned the name of one who has been responsible for the existence of the Tea Research Institute more than anyone else, and that is the late Mr. R. G. Coombe.

Time is passing and once again I would like to thank you for your presence here, and for your comprehensive address which we shall be very interested to study in more detail when it appears in print as I hope it will.

Finally, I would like to refer to the words of H.E. the Governor-General when he was addressing the Conference held two years ago. He referred to the importance of the tea industry to Ceylon and those who heard his address will remember him saying:—" Any owner of land who merely seeks to exploit it and to snatch quick profits, who takes all and puts back nothing, is like a defaulting trustee and it is both the interest and the duty of the beneficiaries to get rid of him."

Once again, on behalf of myself and those assembled I thank you for your illuminating and interesting address.

THE WORK OF THE INSTITUTE

J. Lamb — Director

At previous Conferences it has been the custom for the Director to review the work of the Institute. Much of the information given has usually already been published ; the paper is somewhat tedious to prepare, and probably rather boring to the listener. On this occasion I propose to blow a loud blast on the T.R.I. trumpet.

The Ceylon tea industry has had good value for the money invested in the Tea Research Institute. Our work on blister blight alone justifies the existence of a research organisation. At the end of 1949 there was a great deal of profound uneasiness about the prognosis of the blister blight disease. The Agency House views on the blister blight situation given at the Symposium held in 1949, apart from expressing grave concern over loss of crop, included the following highly significant statement.

> " One of the repercussions can be seen in share price lists where shares from Companies holding estates in the North East and Low-country districts are very firm, whereas the same cannot be said of Companies where their main holdings are in the South West monsoon area."

The situation is very different in 1953. There is now so much confidence in control measures that blister blight is no longer even a topical subject, and I now formally claim that the Tea Research Institute has helped to avoid nothing less than a disaster. I say *helped* very deliberately because the planter, the kangany and the labourer were ultimately responsible for the success of the methods we recommended.

I cannot refrain from mentioning the previous triumph over Tea Tortrix because, apart from the economic aspects of the pest, it was, from the purely scientific point of view, an outstanding example of the successful biological control of an economic pest.

No more complete justification for long term field experiments could be found than in the manurial experiments carried out over the past 25 years. The thirty-fourth report of the Commonwealth Economic Committee on the Survey of the Trade in Fertilisers reveals that the total import of fertilisers into Ceylon is quite surprisingly high. For instance, we consume almost as much potash as the whole of India, nearly as much as Australia and twice as much as New Zealand. As the tea industry consumes about 80% of the total fertiliser imports into Ceylon it indicates a highly advanced attitude towards the use of mineral fertilisers, and a general policy aimed at the complete replacement of removed nutrients. Fertiliser firms have very kindly supplied me with figures for the actual sales of fertilisers to tea estates during 1952. The figures are approximately :—

Sulphate of ammonia	54,000 tons
Saphosphosphate	19,250 tons
Potash salts (50 & 60%)	12,750 tons

Comparison of the proportion of these ingredients with those in our recommended mixture T.R.I. 500 is most gratifying :—

	Sales	*T.R.I.* 500
Sulphate of ammonia	63%	64%
Saphosphosphate	22%	21%
Potash	15%	15%

We recommend the use of 625 lbs. of T.R.I. 500 for every 1,000 lbs. of crop. Assuming that estates produced approximately 300 million pounds of tea they should have consumed 84,000 tons of fertilisers. Sales to tea estates were approximately 86,000 tons.

It is evident that our advice is followed very closely ; let me give you another example. Prior to 1948 the average level of potash consumption was 6,000 tons. In 1948 we recommended the use of increased amounts of potash. In 1949 the imports rose suddenly to 13,000 tons and have remained at that level.

Having, I believe, firmly established that our advice is followed very closely, I will proceed to claim that it is sound advice. Taking the average of exports of tea in 1939, 1940 and 1941, and comparing the figures with the average for 1950, 1951 and 1952, which is, I think, a very fair comparison, we find an annual average increase of crop of 69 million pounds. Value this increase at the modest figure of Rs. 1/50 per pound and it amounts to Rs. 100 million.

This confirms the generally accepted fact that scientific research pays dividends. When I was last on the continent of Europe I asked the Director of a large industrial laboratory if he could tell me how much his Company spent on research and he promptly replied " 1% of the annual turnover." If this were true of the tea industry we would be spending 4.5 million rupees.

In the United Kingdom 0.3% of the value of the gross agricultural output is spent on agricultural research quite apart from the National Agricultural Advisory Service and various teaching centres. Taking the average price of tea at Rs. 1/50 per pound to avoid any argument, we would on this latter basis be spending 0.5 cents per pound on research alone. At the present moment our research cess is 0.25 cents with .05 cents temporarily added for special blister blight work, the last instalment of which is due this year.

Not only do we have to carry out research work on this cess but also advisory work. For the past few years some 10,000 letters *per annum* arrive at the Institute and an equal number are sent out apart from the postage of publications, circulars, etc. Over 1,000 circulars go out in connection with a Conference. Advisory responsibilities have increased to the point where they have become a burden. We accept them as a normal part of our duties and have not kept any detailed records, but as a matter more of curiosity than anything else, I kept a record of visitors to my own office between the 5th and 31st of January this year. I had 22 visitors taking 36 hours of my time. In this period the Technologist had visited nine different factories ranging from the Agras to Badulla. In the first eighteen days of February he visited five more factories ranging from Maturata to Deniyaya. It is becoming almost impossible to carry on research work on tea manufacture.

Direct advisory work does not end the matter for there are " *Tea Quarterlies*," Monographs, Annual Reports, Meetings and other matters to attend to. A monograph on tea manufacture is now long overdue. Rightly or wrongly I have taken a firm stand against teaching activities except for short specialised courses of instruction on spraying.

For our Small Holdings Advisory Service we have a supplementary cess of 0.05 cents and spend 0.015 cents from our general funds which reduces our research funds still further.

Although our cess was increased in 1949 from 0.14 to 0.25 cents per pound of tea exported, this increase was not proportional to the rise in our cost of maintenance. In 1952, I calculated that our income had risen 1.75 times over the 1939 revenue, whereas our maintenance costs had increased 2.25 times. The insistent demand for a low-country Sub-Station also contributed to the increase in our maintenance costs.

Even barely to maintain our normal scale of activities, we must have more revenue and more staff. In recent years we have lost a tremendous fund of knowledge and experience through the death, or retirement, of officers who laid the foundations of the Institute. Even with additional staff, and it is extremely difficult to find men with experience, the burden on the present staff will be heavy for some time to come, unless we deliberately curtail our activities in research on manufacture, and on entomological problems.

Our financial reserves are now completely exhausted, and if we have to continue on our present revenue, drastic steps must be taken this year to cut down our activities. The result of such steps will be an inevitable decline, first to the status of a mere advisory bureau, and finally to oblivion, because advisory work *must* be based on research, and competent research workers will not stay in an institution where pre-occupation with advisory duties prevents research progress.

COMMENTS ON THE DIRECTOR'S REVIEW

H. J. Temple

The Report just read by the Director compels our closest attention. He says the finanical reserves of the T.R.I. are now completely exhausted and if we continue on the present revenue, drastic steps must be taken this year to cut down the T.R.I. activities. Now that is a warning it is necessary to emphasise, and he gives some examples of the way in which the industry has profited from T.R.I. work.

For the purpose of what I am going to say, I will repeat one remark the Director made. Mainly as a result of the tea industry following the recommendations of the T.R.I. after research on manuring and on blister blight, there had been an average annual increase of 69 million pounds of tea output representing Rs. 100,000,000 a year. Yet the Institute that has brought about these startling results is hard-up. Its coffers are empty ; its reserves exhausted ; on the present revenues the Institute must cut down its activities.

There are one or two things the Director did not mention but which I propose to mention. Do we all realise that seven times as much is spent on the promotion of the consumption of tea as on the protection of its production. If we agree that the expenditure of Rs. 1/70 per 100 lbs. of tea is necessary for propaganda to maintain and increase the consumption of tea then surely we must agree that it is at least equally important to protect the production of tea against the many pests and diseases to which it is subject. In comparison the expenditure of only 25 cents per 100 lbs. of tea on research compared with Rs.1/70 on propaganda appears — shall I say — modest. We must not forget the disaster that so rapidly overwhelmed coffee without scientific research, nor must we forget that the salvation of the tea industry in the last three years has been due to the activities of the T.R.I.

We are told the financial reserves are exhausted. If the T.R.I. is compelled to restrict its activities there is danger to the industry, and with restricted resources, the Board may feel it cannot afford to pay the salaries the best scientists can command. It is not my business to deal with individual cases, and I would like to give you a few figures I have taken from the published accounts of the T.R.I.

In 1939 — before the War — the T.R.I. spent Rs. 103,000 on Scientific Senior staff salaries and Rs. 36,000 on Junior staff. In 1950 — the last year for which I have found published accounts available — the Senior staff cost, including Dearness Allowance, Rs. 103,000 and the Junior staff Rs. 95,000. The total expenditure of the T.R.I. in turnover in research work in 1939 was Rs. 359,000 but in 1950 was doubled at Rs. 750,000.

There is something that seems a little strange to me in those figures. We all know that everything has gone up in cost — at least double — since prewar, but the cost of the Senior staff is unchanged.

The Director said that the Institute had lost a tremendous fund of knowledge and experience through the death or retirement of officers. But that is not the only reason for loss. We have the instance of a scientific officer whose research work for years in Ceylon was of quite incalculable value, but all his scientific knowledge and experience, accumulated over a number of years and applied to Ceylon conditions were lost to Ceylon because another younger country with a very much smaller production could afford to pay him a more attractive salary than Ceylon.

Now we are all proud of the T.R.I. and have good cause to be proud of its achievements. We are gratefully appreciative of the time and thought given to the T.R.I. by the members of the Board of Control and we are profoundly thankful to the scientific staff for the research and advisory work they have done. The T.R.I. is a vital and all-important part of the tea producing industry, and we don't want, and we must not allow, its activities to be restricted.

We are all, as shareholders or proprietors, contributors to the T.R.I. funds, and I hope this meeting will support me when I say that we want the Board of Control to know that we don't want the research work of the T.R.I. to be restricted through lack of funds. It would indeed be highly dangerous to the economy of the tea planting industry and to the economy of Ceylon to restrict research. The responsibility lies with the Board and if they, with their scientific advisers, feel that the present revenue is altogether inadequate they should unhesitatingly ask for and arrange for the already small cess to be increased. And, may I say that the best scientific staff is the most profitable in the long run, and we want our scientific staff to be paid adequately so that they may feel happy and contented in Ceylon.

Chairman : I thank you, Gentlemen, for the manner in which you have received Mr. Temple's words. I would mention that a special Committee is sitting at the moment on this matter ; and I feel assured that, if this Committee recommends an increase in the rate of cess, the Board will receive its recommendation favourably. I am glad that all present are in favour of an increase, and I trust that the Ceylon Association in London will support the opinion of this Conference.

Sir Oliver : I would like sincerely to assure my old friend Mr. Temple, and all of you present here, that as soon as the Board is able to state what the cess of the Tea Research Institute should be, that the wishes of the industry will be implemented as soon as departmental procedure will allow. There may have been some delay in regard to the interim demand made for an increase in the cess for the expansion of small holdings service, but this was entirely due to the fact that Government was considering whether the problems of small holders of tea should be covered by a cess over the whole industry. That question has now been answered and I am prepared, as soon as you are able to advise me of the increase of the tea cess that is necessary, to meet all requirements of the Tea Research Institute, to do everything possible to see it through with as little delay as possible. I further certainly endorse Mr. Temple's views that it would be complete suicide not to give adequate resources to the Tea Research Institute.

Chairman : I thank you, Sir Oliver, for your words of encouragement and for your assurance of passing on our recommendations to Government for the adoption of legislation for an increase in the rate of the cess.

THE PRINCIPLES OF MANURING

J. Lamb

To commence I wish to make it clear that this introduction deals only with principles. I used the word introduction deliberately because the object is to initiate a discussion which I hope will result in some agreement on how manuring should be carried out in practice. I shall be provocative, and I know you all have your own ideas on the subject. We have allowed forty minutes for a discussion which I hope will be lively and spirited.

There is a common fallacy that the growth of the tea bush may be stimulated by so-called artificial manures, very much along the lines of giving an old hen some laying spice. These misleading and indeed rather dangerous ideas are sometimes carried further, alleging that nitrogenous manures stimulate vegetative growth, that potash makes wood, and that phosphates stimulate root growth. The actual stimulants to growth are light, warmth and plant hormones or growth promoting substances, over which we have no control in estate practice. Mr. Webster's paper this afternoon will give you an insight into some possible complexities of growth promoting substances.

An impression of stimulation may be given by correcting some *limiting factor*, and to claim to have stimulated the growth of tea bushes is only to admit an error of management up to the time the apparent stimulation is observed. There are many well tried methods of limiting the growth of the tea bush, the commonest being to leave insufficient maintenance foliage or, in other words to over-pluck. Other well known methods are hacking, chopping or sawing of frames by the use of various cutting instruments, smashing of frames, for which purpose over-grown shade trees may be used, the destruction of roots by over-cultivation and so on.

The limiting factor with which I am concerned in this talk is the supply of nitrogen, phosphate and potash. If these elements are not available when other conditions are favourable the potentially possible amount of growth cannot be sustained.

Assuming that we have a healthy bush with a substantial frame, there will be periods when light and warmth stimulate the leaves to absorb carbon dioxide from the air. Incidentally, I make no apology whatsoever for telling you all about carbon dioxide once more. Carbon dioxide and water constitute 90% of the crop and no amount of manure can substitute them. Adequate maintenance foliage is absolutely essential. As soon as the leaves commence to absorb carbon dioxide, growth commences and is sustained, so long as the supply of water and minerals is sufficient. Light and warmth cannot sustain growth without water and minerals and even when light, warmth and water are all adequate, growth will be limited when nitrogen, phosphate and potash are not available in adequate amounts, and in the correct proportions to take their appointed place in the complex structure of the plant. The most highly organised and generally well supplied building work must stop if any essential component, however small, is missing. In the case of plants it may be only traces of an essential element, but that is another story ; we are concerned with nitrogen, phosphates and potash.

The principle of manuring is, therefore, to ensure that adequate amounts of these nutrients are ready when called for. I do not propose to confuse this principle by going into complicated details about availability, base exchange complexes, fixation

and so on. Instead, I urge you to give the utmost attention to the supplying of humus forming, NOT necessarily nitrogenous, materials and to the protection of soil from over-heating because these measures will ensure an ample supply of readily available nutrients at all times, and may be likened to a sound bank balance, both on current and on deposit account. Nevertheless, I remind you that plants can be grown on sand if a continuous supply of all essential nutrients in a balanced solution is maintained, and that even sand with incorporated humus can gradually be built up into a reasonable soil. I repeat, therefore, that the principle of manuring is to ensure that adequate amounts of nitrogen, phosphate and potash are ready when required.

Just how long it takes sulphate of ammonia, ground rock and phosphate and potash to become available to the tea bush after application to the soil, I cannot tell you ; it probably varies enormously with soil and weather conditions and a host of other factors. Anyway, it is beside the point because the principle should be to maintain a constant supply of these nutrients. It is impossible to forecast the demand and the nutrients must be literally " on tap." Even with the poorest tea soil there will be some capacity for holding nutrients and soil improvement is mainly a question of improving this capacity. The art of manuring is to keep this reserve full, and skill and judgment must always be a part of agricultural practices. No amount of scientific research or advice can completely eliminate an element of skill and experience in agriculture.

Precise field experiments of the type laid down by Dr. Eden, 25 years ago, exact chemical analyses, and skilled observation can, however, eliminate much guesswork and I am not aware of any evidence which supports the use of a routine mixture varying from T.R.I. 500 for use on tea in bearing.

T.R.I. 500

Ammonium sulphate	—	320 lb.
Saphos phosphate	—	105 lb.
Muriate of potash 50%	—	75 lb.
(or Muriate of potash 60%	—	63 lb.)

There is no special magic in this mixture but it is the most fully informed guess that can be made for Ceylon conditions at the present time. Some time in the future we may find cause to modify or supplement this mixture but at present it appears to meet the needs of the tea bush wherever it is grown on Ceylon soils.

I suggest that there are great advantages in the use of a standard mixture because fertiliser firms can supply it at short notice, and it should not normally be necessary to store it on the estate for a length of time sufficient to require the incorporation of a conditioner. When a conditioner to prevent caking is considered desirable, the advice of the supplier should be sought in connection with the type an amount of conditioner to be used. It will increase the cost of the mixture. At the present time it is cheaper to use the 60% muriate of potash.

A few moments ago I described T.R.I. 500 as a *routine* mixture. Where there has been a long history of potash starvation, we sometimes recommend one application with additional potash but this is for the active treatment of a deficiency. Such deficiencies will not arise if T.R.I. 500 is used as a routine in adequate quantities. The next point therefore is how much T.R.I. 500 should be used to maintain soil reserves, and to ensure that there is always sufficient nitrogen, phosphate and potash to supply the demands of the bushes during periods of active growth. The principle is to pay into the nutrient banking account at six or nine monthly intervals lump sums sufficient to cover withdrawals.

Do not apply manure in the hope of getting it back converted into leaf — in the same spirit as you would put a coin in a cigarette or chocolate machine expecting to obtain delivery of your purchase when you pull a handle. Pay manure into the soil

to compensate withdrawals and to keep your bank account in a sound condition. Every field must have a separate account. To manure a whole estate at one level is to waste manure in low yielding areas and to starve other potentially more productive areas.

For many years we have been somewhat reluctant to publish any form of manuring guide because in general terms we can only recommend *minimum* quantities. We cannot any longer cope with the amount of work involved in advice to individual estates and in any case, judging from the figures I gave you earlier[1] in connection with sale of fertilisers during 1952 it is evident that a greatly predominant proportion of estates must be manuring on a basis closely approaching our advice. I do, however, stress that the table we will now publish should not be used mechanically. Fields which are showing a rapid increase in yield must be manured above the level suggested in the table. Heavy stands of shade trees and green manures may deserve some consideration. Especially I mention very wet districts where responses to mineral fertilisers may be much lower than the average. Again, I mention skill and experience as indispensable adjuncts to tea planting. If your experience is that 82 lb. of nitrogen is not enough to sustain an yield of 1,000 lb. per annum, then interpret our table accordingly. I am particularly anxious that agents and controlling interests in offices remote from producing areas should not interpret this table too literally. The opinion of an experienced planter is an indispensable part of management and advice from research organizations must never be allowed to usurp the place of practical experience. Plants and soil cannot be managed according to any exact system of organization or accounting.

Subject to the limitations I have discussed, the relation between yields and the quantities of manure required to sustain yields may be tabulated as follows :—

Crop lb.	*T.R.I. 500 lbs. of mixture required (–2% if 60% muriate is used)*	*Application per annum*		
		Nitrogen	*Phos. Acid*	*Potash*
400	275	36.0	17.0	21.0
450	300	40.0	19.0	23.0
500	325	43.0	20.0	24.0
550	350	46.0	22.0	26.0
600	400	53.0	25.0	30.0
650	425	56.0	26.0	32.0
700	450	59.0	28.0	34.0
750	475	63.0	29.0	36.0
800	500	66.0	31.0	38.0
850	525	69.0	33.0	39.0
900	550	73.0	34.0	41.0
950	600	79.0	37.0	45.0
1000	625	82.0	39.0	47.0
1050	650	88.0	40.0	49.0
1100	675	89.0	42.0	51.0
1150	700	92.0	43.0	53.0
1200	725	96.0	45.0	54.0

Since many planters are accustomed to thinking in terms of pounds of nitrogen per acre, the actual analysis for each quantity of manure is given but I draw your attention to the fact that in every day practice, using a standard mixture, it is redundant to give the analysis for each and every field. The habit of thinking in terms of pounds of nutrient is a good one but simplicity in practice and in routine records is

[1] The Work of the Institute — Director, p. 8 of this issue.

even more desirable. I do, however, suggest that wherever pounds of mixture are referred to in permanent records, the composition of the mixture should inavariably be given, otherwise it will be extremely difficult in the future to elicit reliable information from those records. T.R.I. 500 may be entirely forgotten in 5 or 10 years' time. I mention the subject because elaborate calculations in manuring programmes are entirely unnecessary if a standard mixture is used. You will note that small adjustments are necessary if 60% muriate is used in the mixture. This really only applies in ordering bulk supplies. For the smaller quantities used in the field the correction is negligible as small differences have no practical meaning.

There seems to be considerable differences of opinion about the practicability of manuring each field, exactly according to its yield since the previous application. Compromise of some description will be necessary as the distribution of manure cannot be controlled to very fine limits. However, yield records can be referred to the table I have given and the exact theoretical amount ascertained without difficulty. The amount actually applied may be adjusted for the sake of convenience in application, and any difference added to or substracted from the next application. The total application for the cycle should however be fully adequate.

Some estates prefer to classify fields according to yield categories and to apply manure on a routine worked out for each category. The evenness of distribution is certainly of the greatest importance and it is little use fussing about the quantity of manure to be applied, if the quantity decided upon cannot be reasonably evenly distributed over the whole field.

Distribution is a question of great importance and I hope you will express your views on this aspect in particular.

Finally, a few words about when and how frequently to apply manure. It is obviously impractical, apart from being undesirable to apply manure in very wet weather or in very dry weather. Manuring is like ploughing, harrowing and other operations involving soil, a matter of opportunity and judgment. The availability of labour is also involved and the matter must be decided by the man on the spot. If manuring is carried out according to the crop harvested in the period between two applications, the table I have given makes it simple immediately to decide how much mixture to apply at any time the weather is favourable and the labour available. There must, however, be some guiding principles and the first application in a pruning cycle should be given as soon as there is a good cover of foliage. With the light pruning now generally practised, this is usually about three months from pruning.

Whilst admitting that our experimental evidence is meagre and that opinion on the point is largely arbitrary, we advise against periods of longer than nine months between two successive applications of manure. This implies that the last application in a cycle should be not more than six months before pruning if the first application in the following cycle is to be given three months after pruning. Nine monthly intervals appear to be satisfactory for fields yielding up to about 800 lb. per acre but for yields above this figure we prefer applications at intervals of six months. All manurial programmes involve some compromise but the principles I have described are simple and are fairly easily adapted to meet varying conditions.

Perhaps some controlling interests and visiting agents maybe a little disturbed by the apparent elasticity of the system resulting from the application of the principles I have laid down. I point out, however, that it avoids wastage of manure, that it avoids starving vigorous fields and that although the total expenditure on manure cannot be exactly estimated at the beginning of any financial year, it is low in poor years, high in good years and that the cost of manure per pound of tea harvested is constant so long as the price of manure is steady. When the total expenditure on manure is decided at the beginning of a financial year the cost per pound for manuring varies with the crop harvested and is high in poor years and low in good years. This does not seem to be sound finance.

THE PRINCIPLES OF BUSH MANAGEMENT

G. B. Portsmouth

My original suggestion for a title for this talk was "Points of Agricultural Interest", since it is my intention to deal with a number of aspects of the cultivation and management of the tea bush which will, I hope, be of general interest.

Vegetative Propagation

Firstly a few words about Vegetative Propagation. As many of you know I have only recently returned to Ceylon after 8 months' leave. However, in the short time I have been back I have already been somewhat disappointed in receiving reports concerning a decline in the interest shown by estates in V.P. work. If these rumours are indeed true then I can only say that they reflect a most short-sighted policy on the part of those responsible. In the present state of our knowledge the vegetative propagation of selected high yielding clonal plants undoubtedly offers the greatest possibilities of rapidly and cheaply increasing our overall yields per acre, with a consequent lowering of cost of production. The inherent possibilities of this method are well illustrated by the yields given by some of our 1947 series clones in their second year of plucking (1951-1952). (Table 1).

TABLE I

St. Coombs 1947 *Series Clones*
Yields in Second Year

Clone No.	*Lbs./Acre*
2024	2,295
2025	1,830
2023	1,685
2022	1,650
2021	1,500
25	1,405

None of these clones have been protected against blister blight and it should be noted that our one time best clone—No. 25—has now been soundly beaten for yield by five more recent selections. This is mainly due to No. 25's greater susceptibility to blister blight since, prior to the advent of this disease, its yields were consistently high. (Table 2).

TABLE II

St. Coombs No. 25 *Clone*
Yields Prior to Blister Blight

Year of Bearing	*Lbs./Acre*
First	1,270
Second	1,665
Third	2,295

These results conclusively demonstrate that not only much higher yields but much increased resistance to diseases such as blister blight can be obtained by continued selection and propagation of new clones. In the case of a clone such as No. 2024 it is obvious that protection against blister blight is quite unnecessary. Similar progress has also been made in the selection of clones resistant to eelworm, a subject which will be dealt with by Mr. Loos during his talk this afternoon.

Now a point of practical importance which has come to the fore in the last year or so. V.P. plants, and to a lesser extent seedlings, are apparently very susceptible to having their stems buried too deeply. Accordingly, when transplanting, care must be taken to ensure that the stems are not buried below the original soil level. Too deep planting holes are a frequent cause of trouble since, when these are filled in, several inches of the hitherto exposed stem may be buried and lead to otherwise unexplained casualties.

Whilst on the subject of transplanting I would like to draw your attention to the new type of transplanter invented by Mr. C. Cameron of Diyagama.

Mr. Cameron is, I understand, here today and I have no doubt he will be pleased to answer any questions regarding his machine during the discussion.

Pruning

When I addressed you at our last Biennial Conference I made a number of not very complimentary remarks about the hard pruning which had been done so extensively in the past and strongly advised you to adopt the light high prune we recommended. Although this advice was extensively followed, a number of you at that time expressed doubts as to whether this lighter type of pruning would run the full cycle. Now fortunately I am able to demonstrate to you by actual yield figures of representative St. Coombs fields that this lighter pruning will run. (Table 3).

TABLE III

St. Coombs Estate

Field No.	*Pruned*	*Yield Lbs. Per Acre*		
		Months 1—12	*Months* 13—24	*Months* 25—36
4	Nov. '48	482	753	1003
7	Jan. '50	287	1104	1063
8	Jan. '50	491	1185	1125
12	Nov. '49	443	1017	1204

All these lighter pruned fields have given over 1000 lbs. acre in their third year and three are continuing in plucking for a fourth year.

It must, however, be emphasised that fields will only continue to yield, however they have been pruned, if they are given adequate manure. With lighter pruning recovery takes place more rapidly and it is, therefore, important to ensure that your first manurial application goes in earlier in the cycle than was necessary with the old fashioned hard clean prune.

Those of you who have visited St. Coombs recently will have noticed that many of our fields are now pruned on the slope. There is much to recommend this method but let me give you a most serious word of warning. Please, please do not destroy the much improved frames you have so carefully built up over the past few years by cutting away the branches on the lower sides of your bushes in order to get your

slope. Get your sloping table by pruning higher on the upper side of your bushes, followed by rather higher tipping on the upper side. On steep hillsides even a combination of proper pruning and tipping can hardly be expected to give you a fully sloped table in one operation. So please do not be impatient and destroy half the yielding capacity of your bushes for the sake of appearances. Instead please wait for the next prune, when if the previous one was carried out carefully, you should have enough new wood developed to enable you to produce your perfect slope without harm to your frames.

Plucking

With regard to plucking I do not propose to say much today except to draw your attention to the results of our long term fish leaf plucking experiment which completed its fourth cycle last year. In addition to records of yields throughout the cycle, samples showing the amount of maintenance leaf carried and pruning wood developed were taken when the bushes were pruned down at the end of the cycle. The figures obtained are shown in Table 4.

TABLE IV

Fish Leaf Plucking Experiment
4th Cycle, 1949–52, Results

	Plucking System		*Fish/Normal*
	(1) Normal	*(2) To Fish*	
	Lbs./Acre	*Lbs./Acre*	
Flush Plucked	2,207	1,993	90%
Maintenance Leaf	3,286	972	29%
Wood	5,830	1,617	28%
Total Growth	11,323	4,582	40%

In this cycle the bushes have obviously become so debilitated that even continuous plucking to the fish leaf has not been able to produce more than 90% of the yield given by normal pulcking, whilst the enormous reduction in the amounts of maintenance foliage and pruning wood carried by the fish leaf plucked bushes is truly alarming. The results of this experiment should indeed serve as a most timely warning to those who may be tempted to take too much and leave too little for the bush. Let me add that in this experiment we do always leave the fish leaf !

Maintenance and Improvement of Fertility

This shocking example of man-made deterioration naturally leads on to a consideration of the other side of the picture, namely, what are the best ways in which to maintain and improve our existing levels of soil fertility.

Now one of the most important operations carried out in connection with the cultivation of our bushes is that of forking. Accordingly, it would appear to be highly desirable that we should attempt to get a clear idea of how this operation may influence fertility levels. For our part, we at the Institute are becoming more and more of the opinion that, under a good cover of tea and probably only under a good cover of tea with a certain amount of mulch under the bushes, too much deep forking is not only unnecessary but definitely harmful. This opinion is mainly based on observational data but it is fully corroborated by one of our long term field experiment, which shows a regular depressant effect on yields, of about 3 to 4 per cent, to result from thrice yearly cultivation as compared with normal once yearly cultivation. Anyway, in support of our opinion, we are now only deep forking our St. Coombs fields once during the cycle, whilst manure is applied in both rows approximately

every 6 months and dibbled into the top soil by means of short forks with about 4 inch tines. That this forking and manuring system is actually achieving practical results can scarcely be gainsayed in view of the fact that last year St. Coombs estate secured its all time record yield of 952 lbs. per acre.

Thatching with Gautemala grass or loppings is another practice which would appear to hold out considerable possibilities for improving our fertility levels. At the moment we are inclined to favour the use of all pruning leaf, leaf-fall and green manure and shade tree loppings to form a thatch or surface mulch rather than have this material incorporated directly into the soil by means of envelope forking. This again is a matter of opinion rather than a concrete recommendation, but we do feel that the benefits to be derived from a thatch, through its action in protecting exposed soil from undue insolation and in conserving soil moisture, far outweigh those which can be obtained by the direct incorporation of the same amount of organic matter into the topsoil layers. In fact the direct incorporation of green manure into our soils may actually turn out to have the effect of reducing their total humus content, since recent experiments in the U. S. A. with sudan grass have shown that the addition of such an easily decomposible material so stimulates the soil organisms that they do not only attack the added green material, but also decompose in the process some of the more resistant organic matter already in the soil.

So far we have very little in the way of clear cut experimental results in connection with thatching. However, it may be of interest to record that an estate scale experiment, in which Guatemala grass thatching at the rate of 15 tons per acre is being compared with compost of an equivalent nutritive value buried in pits, does show an increase in yield of some 50 lbs/acre in favour of the thatching treatment after one year.

The best time to make use of material such as Guatemala grass, grown outside your fields, for thatching is, of course, at pruning when the maximum amount of bare soil is likely to be exposed. Besides protecting the soil, such a thatch is likely to have a marked effect in suppressing weed growth and so will reduce weeding costs.

Another method of protecting exposed soil and improving fertility is by the use of ground covers. One of the best of these would seem to be *Stylosanthes gracilis*, which is now being tried out with considerable success on a number of estates. Let me quote from a letter we received from the Superintendent of an estate in the Galaha district, who has had an area of *Stylosanthes gracilis* growing in his tea for some two and half years. After taking the trouble to have samples of soil taken from under *Stylosanthes gracilis* and from a similar clean weeded area, analysed, he reports as follows—

"No weeding was necessary on the cover area for the last two years. It has shown itself to be quite prostrate with no tendency to wind in the bushes and very easy to control. The marked improvement in porosity and water retention, combined with the crumb structure, would seem to show that the theory that deep cultivation is needed to aerate the soil is fallacious, while the change in soil colour is evidence that organic matter is metabolised into humus and retained in the soil when the surface is protected, whereas it is largely destroyed when the surface soil is exposed to the elements."

The advantages of a suitable cover could not have been put better and I have nothing to add except to say that on St. Coombs the increase in the earthworm population under *Stylosanthes gracilis* cover is quite phenomenal.

Little time is now left me so I will conclude by expressing the hope that at our next Conference I will be in a position to report that a proper policy of high shade rotation has been put into operation on many more estates than is apparently the case today.

IMPORTANCE OF REPLANTING

W. J. Childerstone

Last month I returned from an extensive tour of the Assam Tea Districts and one particular feature of their excellent agricultural practices impressed me so strongly that I felt compelled to ask for this intrusion on the platform in order to give this subject the publicity I consider it deserves.

On the first morning of my tour I was waiting in the garden for my host, and facing me was one of the finest sheets of tea I had ever seen. You can imagine my horror when a gang of labourers appeared and started uprooting bushes that any Ceylon Proprietor or Planter would have given his soul to possess.

My host joined me and I immediately asked him the meaning of this extraordinary procedure. His reply was, " that field only gives 1,300 lbs. an acre — nothing under 1,600 lbs. is any use to us, so we are replanting it."

Lack of time compels me to cut a long story short. The essence of what I have to say boils down to the fact that Assam is fully convinced that the ECONOMIC LIFE of their tea is between 50 and 60 years, after which, yield progressively decreases. I visited Tocklai Research Station and was assured that yield records kept over many years demonstrated their contention. At first I wondered whether this had anything to do with their pruning system of just a cut-across every year. But every means of rejuvenation by the knife has been tried without success ; while increased applications of fertiliser have no effect in checking the slow deterioration in vitality. In other words, tea like every other form of life reaches a peak of maturity, (in this case about 60 years) after which vigour starts deteriorating. If this is true of Assam I see no reason why our tea in Ceylon should be more fortunate in its span of life.

In Assam they have adopted a regular replanting policy based on 2% of their acreage every year, and many of the estates started this over twenty years ago. It must be admitted that for them it is a very much easier undertaking. The land is dead flat and the soil is entirely free of rock. Indeed it is said that there is not a stone in the whole of Assam. Labour costs are lower, and replanting provides useful work during the winter months. After uprooting, mechanical preparation of the clearing can be carried out. Finally, very high yielding strains of seed have been developed and crop can be harvested within the third year from planting.

Nevertheless, in spite of the problematical and difficult conditions here, if the contention of old age deterioration is accepted, it would appear absolutely essential for Ceylon estates to begin a policy of replanting, if we are to avoid eventually finding ourselves trying to survive on a slowly shrinking economy.

Apart from the question of age, much of our older tea is too widely spaced and there is no doubt that it is lack of proper cover which is our principal handicap. In Assam they do not think in terms of the individual bush — it is the plucking table that concerns them, and that table must be 100% cover.

If by correct methods of replanting we can achieve a complete cover, our main nightmares, from the agricultural aspect, are automatically solved. Weed growth is smothered, erosion checked and tilth of the soil maintained by a jungle of tea. From the commercial aspect we all know too well that cost of production can be substantially lowered only by increase in yield. On our present comparatively low yields a drop of 50 lbs. an acre can often sway the balance between profit or loss.

However, the main point I wish to spotlight is this vital problem of the age of tea, which I am sure you will agree, merits very serious consideration from all those responsible for the future. We have perhaps been waiting too long for the perfect blight-resistant, high-yeilding, high-quality clone to be developed. I feel sure that on a long term policy — and no agricultural pursuit can be anything but a long term policy — we should start energetically tackling the problem now, and not continue postponing this task until it is too late.

The first question which needs answering is, of course, " Can it be done successfully? ", for we all know there have been failures in the past. No doubt the answer will contain many provisions, but I feel sure the Director of the T.R.I. could give us some valuable information on the recent experiments in replanting on St. Coombs, which would give us a lead when undertaking our first attempts in replacing our old tea with vigorous young stock.

A NOTE ON MECHANIZATION

S. J. Wright

Ceylon tea uses more labour than any other large-scale crop in the world. The number of workers on a typical tea estate is about 25 times as great as on a farm of the same size growing crops with a high labour requirement in the United Kingdom. The opportunity for using mechanical appliances to raise production per worker is, therefore, very great.

On most estates there is immediate scope for using tractors, and readily available equipment, for all the work of lifting and carrying materials and for road-making. But in established tea, even on land with no steep slopes or rock, there is little possibility of using tractors or any other self-propelling equipment in actual field work.

The main obstacle is the existing arrangement of the bushes themselves, and the impossibility of manoeuvering between and around them. Because of this immediate mechanization is possible only at the level of the appliance, like the mechanical plucker or the mist blower, if carried together with the engine on the coolie's back. But as and when tea is replanted, or new tea is opened, there is no reason why a substantial degree of mechanization should not be introduced, provided that the necessary experimental work is put in hand right away. One side of the work would be concerned with finding out the best arrangement of bushes ; and another with the development of suitable equipment for use on fairly steep hillsides.

Given a suitable rearrangement of the bushes, perhaps twenty per cent of the whole tea area might be worked with ordinary tractors ; while with special, but not necessarily complicated equipment that should result from experimental work, up to sixty per cent of the total area might be tackled. In conjunction with mechanically operated winches for bush pulling, the same equipment would materially reduce the cost of replanting.

THE PRINCIPLES OF MANUFACTURE

E. L. Keegel

At the outset I wish to state that the subject of my talk today is not how to make tea. So much has been written in the last two decades on what to do and what not to do in tea manufacture that this science — call it an art if you like — is no longer a closed book to most planters. What I propose to talk about are general principles and not whether you roll your leaf four times or continuously, or fire your teas on a slow or quick pulley. Specific problems there are, I do not deny, but the biggest single factor which contributes to the character of a tea is the quality of leaf from which it is made.

The overwhelming importance of plucking as a factor influencing the finished product was stressed in great detail in my last article in the "*Tea Quarterly.*" It only remains to add that since the publication of this article a long-term experiment, comparing a 7 day plucking round with a 14 day one is being carried out at St. Coombs. The teas from these two treatments have been so dissimilar that one tea taster in fact remarked that he could hardly realize that they came from the same estate, let alone from the same field. You will be surprised to hear that even flavour, that rare characteristic which is so highly valued, is affected by the standard of plucking.

The extent to which leaf influences every stage in manufacture is, however, not clearly apprehended by many planters. An uneven wither can be traced to poor leaf ; low dhool outturns can be due to coarse leaf ; a dull infusion is a natural contribution from bad leaf—light rolling and low temperatures will not improve infusions from coarse leaf, as is generally imagined. A plain liquor and poor appearance are two other contributions from leaf of a low standard. But for all that if you look up any tea taster's glossary you will find that except for stalk practically every undesirable characteristic in a tea is supposed to result from incorrect withering, or incorrect rolling, or incorrect fermentation, or incorrect firing, or incorrect sorting. This, I believe, has lulled many planters to a false sense of security so much so that if something goes wrong with their teas they imagine it is in the factory and nowhere else. When a simple correction in the field would in some cases have automatically solved the problem, futile efforts are made instead, in devising new manufacturing techniques.

Now for manufacture proper. One of the primary elements of successful manufacture is factory organization no matter how high or how low your standard of plucking may be. Organization simply means an orderly arrangement of different operations. It does not mean merely keeping your driers fully loaded or the collection of a vast amount of figures. The real essence of proper organization is a system of control which ensures consistent results day after day. If a factory is well equipped as regards machinery and withering space, there is no excuse for haphazard manufacture. And by haphazard manufacture I refer mainly to the following :—

(1) Lack of intelligent anticipation of the amount of withered leaf to be expected.

(2) Unweighed roller charges (believe me this is still being done in some factories), or charges measured by baskets.

(3) Delays in rolling and roll-breaking.

(4) Depending on the uncertain availability of rollers and roll-breakers.

(5) Driers running empty, or delays in firing owing to lack of control in the rolling room.

(6) Overcharging of rollers in order to work driers at their maximum capacities.

I now come to the next important consideration in manufacture, namely, factory hygiene. It is just as important eliminating harmful bacteria in manufacture as keeping foreign matter out of the tea. Cleanliness should be the watchword particularly in our rolling rooms. Fresh air and fresh water, and plenty of both are the only ingredients required.

As regards withering, which is really nothing more than a preparation of the leaf for rolling, the fundamentals to be observed are correct temperatures and thin spreading. So much stress has been laid on dry bulb temperatures and hygrometric differences that the wet bulb temperature of the air is often ignored. This temperature is also important as it governs the temperature of the leaf. The thinner the leaf is spread the quicker and more even is the wither and this fact should, when space permits, not be lost sight of whatever may be the apparent saving in labour resulting from thicker spreading.

In rolling the main thing to be observed is satisfactory circulation of the leaf under pressure whether applied from the top with a pressure cap or laterally with the less familiar E.P. fitting. To make the best of the leaf adequate pressure is necessary for twisting it and rupturing the cells. The importance of circulation of the leaf in the rollers need hardly be emphasized.

Fermenting of the dhool adds only colour and smoothness to the liquor. According to experimental evidence a serious loss of quality occurs after about 4½ hours and liquors are too green and raw up to about 2½ hours. In practice it will be found that if fermentation periods of the different dhools and of big bulk lie within this range there is no fear of under-fermenting or over-fermenting leaf under the conditions obtaining in Ceylon tea factories.

Firing happens to be a process which is taken too much for granted. Exhaust thermometers are rarely looked at, and I know of quite a number of factories that even do without these important instruments. The exhaust temperature is the only guide to correct firing and this statement applies to final firing as well. Yet how many estates are there that really observe any principle in the final firing of their teas ? In the absence of moisture apparatus what guarantee is there that the correct amount of surplus moisture is driven off ? Final firing, it must be remembered, only checks deterioration that has started in the tea. It does not bring back the original properties of a tea ; it is important, therefore, that every precaution be taken to prevent teas from absorbing too much moisture after they have left the drier.

In grading the main principle to be followed is the taking out of true grades considering not only the size but appearance and liquoring properties as well because it is all these features which go to make any particular grade. That is to say, grades must conform strictly to their trade names. The practice of merely chopping up teas to produce grades such as B.O.P. and B.O.P. Fannings, for instance, only results in a marked lowering of the general standard. Good grades cannot be specified entirely by mesh size.

An outline of manufacture will not be complete, I am sure, without some reference to factory records. Percentage dhool outturns can be most misleading and convey no meaning unless the size of the dhool is taken into account. A 20 per cent dhool through a No. 4 mesh is obviously altogether different from a similar outturn through a No. 6 mesh. The amount of rolling leaf receives can, therefore, not

be gauged by figures alone. Another meaningless term in manufacture, in the sense that it does not measure the degree of wither, is percentage wither. All that it does is to indicate the amount of moisture lost in withering. Of what use is this figure to anybody unless the moisture content of the green leaf is known ? The rational and only way of describing the extent of a wither is by calculating the percentage outturn of made tea to withered leaf. The period of fermentation can also lose much of its significance if there is no information on the period of fermentation of each dhool. A 2½ hours fermentation with an overall period of 2 hours is certainly not the same as a 2½ hours fermentation with a charging interval of 40 minutes. The percentage outturn of made tea to green leaf is yet another figure from which nothing can be inferred if arbitrary deductions are made for surface moisture in wet leaf and for waste in the fired tea. I have taken just four points from factory records that strike me as most unreliable when interpreting results.

To sum up, if you have good leaf, you may have short withers or long withers, hard withers or soft withers, long rolls or short rolls, and still make a good tea. But you can easily spoil that leaf by failure to observe what I regard as the five cardinal principles which are : organization, hygienic conditions, even withers, good circulation of leaf in the rollers and the correct moisture content of the made tea. These I consider to be the main factors other than the leaf which can either make or mar a tea. The period of fermentation is not so important. In short, an understanding of the principles is not enough unless you take into consideration the quality of the leaf as well.

Genetic variations in the leaf, commonly referred to as Jat, are, of course, difficult to correct. That these exist to a marked degree is beyond question. Those of you who have made a study of the characteristics of some of the individual bushes on your estates will no doubt have found some startling differences — infusions from the greenest you can ever imagine to that much sought-after " bright as a new penny look " and liquors that may taste like boiled cabbage water or leave your gums tingling long after they have been sipped. A high proportion of unsatisfactory jat can defy all attempts to improve teas. In such a case the only advice I can give is to develop some favourable characteristic inherent in the leaf. It may be appearance, infusion, colour, strength or pungency. If none of these is present, replanting with suitable material is the only solution.

One final word. Do not be misled by results obtained from isolated experiments. With the poor facilities available in commercial factories for strict comparison between one treatment and another you might find yourself backing the wrong horse. Tests over a prolonged period are necessary before a logical conclusion can be drawn. Even then dangerous and false ideas may be inferred.

There is no hard and fast rule in tea manufacture — there never can be — but I hope that the principles I have enumerated will lead to a better understanding of what takes place after the leaf has left the plucker's hands.

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MYCORRHIZA

B. N. Webster

The title of my paper may be new to some of you so I must hasten to define my subject. The word mycorrhiza means, by definition, " a fungus root," being derived from the two Greek words for fungus and root. I would like here to express the hope that the remainder of this paper will not prove to be " all Greek " to my listeners.

The study of living plants in both natural and man made environments, more particularly with regard to their interactions with other living organisms, is an increasingly important and popular aspect of botany. Of the many living organisms which can affect higher plants probably none are more important than those bacteria and fungi which inhabit the soil, particularly that soil around the root systems of growing plants, the rhizosphere. The activities of many of these "unpaid millions" in the breaking down of humus, and in the maintenance of nitrogen availability, are well known to many of you, and it is not proposed to discuss them. I shall discuss the part played by those particular soil fungi which form a more or less regular association with the roots of certain plants. Some authorities claim that all higher plants are affected.

Explanation of the two types of mycorrhiza

Two principal types of mycorrhiza may, for facility, be defined. In both of them the invading fungus and the host roots form a close and constant association. The first (Fig. 1), or *ectotrophic* type is characterised by the presence of a closely woven sheath (s) of fungus mycelium, (*i.e.*, fungus threads) which completely envelopes certain, usually specialised short roots, of the host plant. The mycelium penetrates the root tissues and forms a continuous net-work between all the cells of the root cortex (Hartig net.). Contact is also maintained with the soil, enabling the fungus to function as "absorbing organ" of the affected roots. Root hairs are usually lacking.

In the second (Fig. 2) or endotrophic mycorrhiza, as the term suggests, the fungus mycelium is found within the cells of the root cortex. It is a moot point whether significant contact is maintained with the soil from the point of view of absorption of nutrients, but in this type also a paucity of root hairs has been noted. The internal mycelium often carries characteristic organs such as the expanded vesicles of unknown function (v) and the branched structures, known as arbuscles (a) which appear to break down under the digestive action of the host cells. It is suggested that this *vesicular-arbuscular* type of mycorrhizal fungus relies much more upon the host, than upon the soil, for its food supplies.

The significance of mycorrhiza

Having described the morphological aspects of the two types of mycorrhiza, I will attempt to give a brief account of their proved significance.

Since 1881, the study of the ectotrophic mycorrhiza of forest trees, particularly of the conifers (pines, etc.) has led to the elucidation of many problems of afforestation. It was found in many areas that conifers could not be easily established on certain poor, sandy loam soils, deficient in humus. The classic English example of which is of Wareham Heath in Dorset where the late Dr. M. C. Rayner carried out a series of experiments on the establishment of conifers. Her first trials consisted

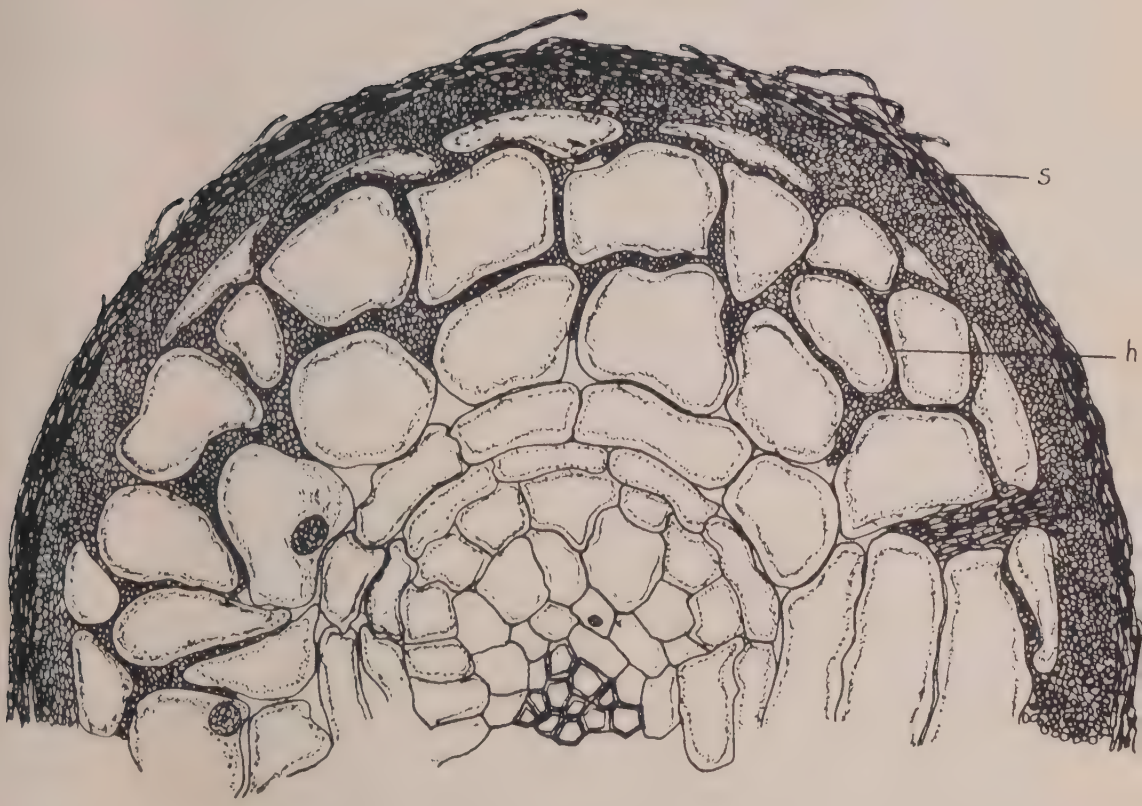

Fig 1. ECTOTROPHIC MYCORRHIZA OF PINE

Transverse section of "short root" of pine, showing fungus sheath (s) and network (Harteg net) (h)

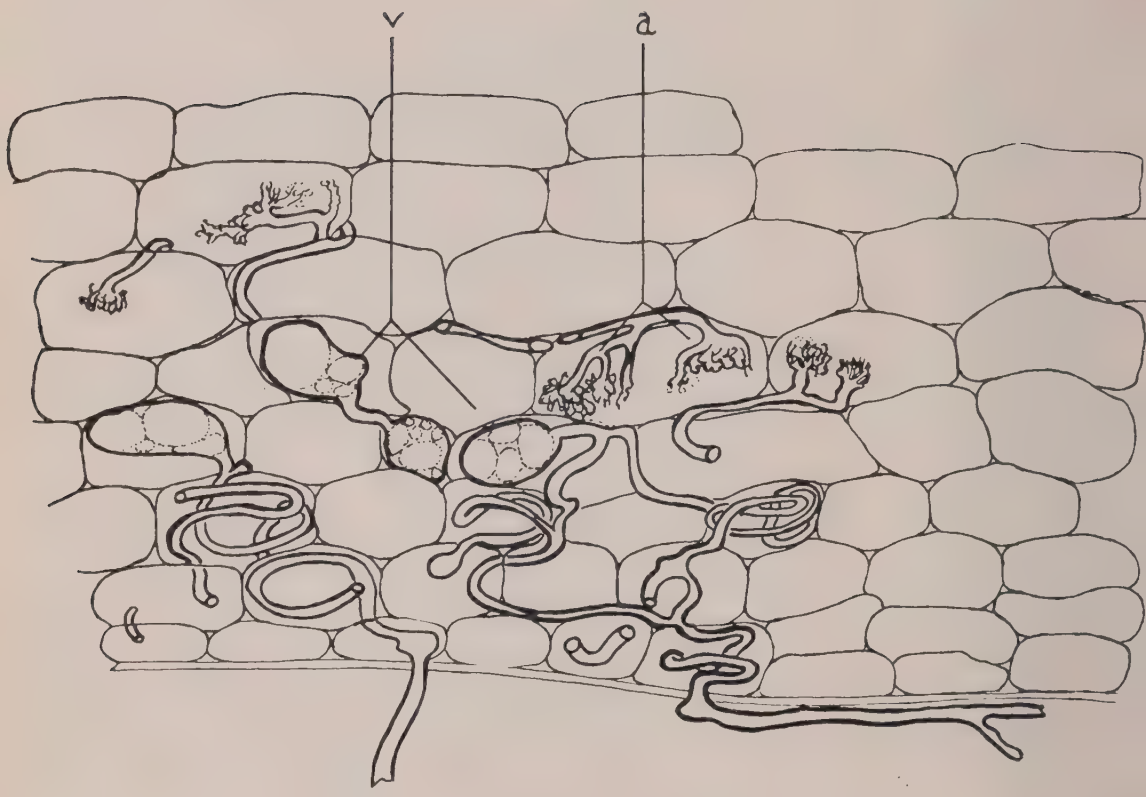

Fig 2. ENDOTROPHIC MYCORRHIZA OF TEA

Longitudinal section of a fine feeding root of tea (T. R. I. Clone 2024) showing vesicles (v) and arbuscules (a), and mycelium penetrating the root. Semi-diagramatic.

of the introduction to the Wareham soils of small amounts of soil from good stands of pine in Sweden and Ireland. The applications were made to the seed holes at sowing time and representative plants were removed after 8 months, weighed and measured. It was seen that the plants grown in association with the " mycorrhizal " soils made considerably better growth than untreated plants.

TABLE I

Effect of inoculation experiments with mycorrhizal humus on growth of pine seedlings 8 months from sowing

Treatment	*Mean height*	*Mean weight*
Untreated Wareham soil	4.5 cms.	0.035 gms.
Swedish humus	5.5 cms.	0.065 gms.
Irish humus	7.0 cms.	0.077 gms.

Root examination confirmed that the treated plants possessed well developed mycorrhizas, whereas untreated plants showed aborted mycorrhizas or lacked them altogether.

On isolating the mycorrhizal fungus Dr. Rayner found it to be identical with that carried by the introduced humus. Although in many soils, such inoculation with a suitable endophyte has a lasting effect, it was found on Wareham Heath that the beneficial effect of inoculation was not continued during the second and third years.

As the lasting effect was not observed at Wareham, it was concluded that the soil was unsatisfactory for the growth of the fungus. An enquiry into the nature of the soil factors inhibiting mycorrhizal formation and growth, showed that, although the necessary fungus was present, the type of organic matter present in the soil was not suited to the mycorrhizal fungus. Applications of various different composts were made and it was ultimately found (after about 15 years) that the factors inimical to mycorrhizal fungi were anti-biotics probably produced by a species of *Penicillium* in the soil. Composting provided an organic food unsuitable for the growth of these antagonostic species, but eminently suited to the growth of mycorrhiza formers.

Work on the significance of endotrophic mycorrhiza has been principally confined to the two families Ericaceae (the heathers, etc.,) and the Orchidaceae. In both families the efforts of investigators have been largely directed to the examination of the effect of the associated fungus on seed germination and subsequent growth of the plants. For many years it was assumed that the majority of orchid seeds would not germinate unless the requisite fungus was present, and that adequate growth and flowering were impossible in the absence of the fungus. Orchid growers, therefore, maintain large culture collections of the specific fungi and orchid culture is a delicate and tedious business. In the last two decades, however, considerable information on the significance of the orchid fungi has been amassed, and several species of orchid have now been brought to maturity in artificial culture. It appears that the principal function of orchid fungi is the supply of plant vitamins, or accessory growth factors which the plant is unable to synthesise for itself, and the supply of suitable soluble nitrogen compounds and sugars. If these are supplied to the orchid in artificial culture then the presence of the fungi is redundant. In nature of course the fungi are still of primary importance to the orchid.

Similar conclusions were reached for heather and, in addition, certain of the heather fungi were shown to possess the ability to " fix " atmospheric nitrogen, *i.e.*,

they assimilate free gaseous nitrogen and pass on to the plant the elaborated nitrogenous products either when digested by the root cells or by transmission through their walls.

A species of fungus morphologically distinct from those in heather and orchids has been demonstrated in a very wide range of higher plants, indeed some workers claim that it will ultimately be found in all families. It is the form found in tea and several other plantation crops, its significance in some of which I shall discuss.

Mycorrhiza in cocoa has recently been investigated in Trinidad. The morphological type found being close to that just described as vesicular-arbuscular. The investigation was confined to two cocoa estates, Las Hermanas and Tortuga, representing respectively a poor, and a very good type of cocoa, from the growth and yield aspect. Both were on similar soils and had received similar cultural treatment. Eight observations were made on representative root samples, taken at random, and the results indicate that the mycorrhizal density was very much higher in the poor, than in the better area, suggesting a possible pathogenic effect.

TABLE II

Mycorrhizal density in good and bad cocoa on soils of similar type.

Mycorrhizal roots %

Observation	*Las Hermanas (Poor cocoa)*	*Tortuga (Very good cocoa)*
1	86	57
2	80	63
3	86	57
4	86	63
5	86	53
6	80	63
7	80	57
8	70	50

The investigators claim no significance for these results, contenting themselves with the suggestion that much work should be done on the problem in view of the apparent absence of true parasitism.

Examination of the mycorrhiza of the citrus trees has, however, shown evidence of parasitism on the part of the fungus. The results of work in California, initiated by Rayner are shown in Table III.

TABLE III

Formation and development of mycorrhiza in citrus.

Manurial Treatment	Growth of fungus	Seasonal effect on fungus	Host reaction
Stable manure & green cover	Heavy at times. Dying out	Only during growing season of host	Defensive Digestion of fungus
No manure	Moderate but parasitic	Nil. Present all year round	Nil
Sodium Nitrate	Heavy parasitic	Nil	Breakdown of root cortex Trees unthrifty

Unfortunately, as is the case with most mycorrhizal investigations, no numerical results are given. Observations on the results of three manurial treatments have been condensed into the table as well as possible, and indicate that the possibility of the mycorrhizal fungus being a pathogen is high. Control is, however, achieved by adequate applications of organic manures. In unfertilised plots, or plots fertilised with sodium nitrate there is no doubt about the parasitic ability of the fungus. It may be claimed that the sodium was responsible for the root breakdown in the last treatment but the workers concerned were satisfied on various grounds that the fungus was responsible.

Similar results have been obtained in strawberry cultivation in Scotland, and in the growing of leguminous crops in the U.S.A. The same type of fungus has been invariably associated with poor soils and bad cultivation, and has, in each case been assumed to be pathogenic.

Mycorrhiza in tea

The known presence of mycorrhiza in tea dates back to 1901, when the organism which we now call *Rhizophagus theae* (Zimm.) Butler was first described under the name *Protomyces theae* as " of unknown significance." Tunstall at Tocklai described and figured in 1930 the same type of mycorrhiza with which we are dealing today in Ceylon. Its presence was again noted by Butler, over a long period in India, and by Sir Albert Howard and his associates in Ceylon tea.

The present work was started as the direct outcome of two independent observations. The first being that although tea soils produce adequate nitrates the tea bush does not appear to utilise them, and the second being an observed difference in density of root hairs between young and old tea, the latter appearing to have poorly developed root hairs. Examination of a random sample of tea roots from a normal field showed that about 75% carried a fungus within their roots. Small amounts of non-septate brown mycelium, were found running along the young white feeding roots, and in sections the points of entry could be clearly seen. No apparent pathological condition resulted. In the first sample examined the mycelium was somewhat scanty and no vesicles or arbuscules were seen, neither were there signs of digestion taking place. A second random sample was then taken from one of the T.R.I. Clonal rows, namely, Clone No. 2024. This proved a good guess as the fungus was found to be most luxuriantly developed, showing many vesicles, arbuscules and mycelial coils, and in addition showing the breakdown or digestion of the fungal hyphae.

Results of the examination of large samples of roots from good and bad areas are not yet to hand as the cutting of hundreds of sections takes rather a long time. Preliminary observations on the bad area suggest, however, that infection is slight. If this is so, it will be entirely contrary to the findings for other crop plants.

As to the possible significance of mycorrhiza in tea, it is much too early yet to form any conclusions.

The scope of the present investigations is wide and must, of necessity, be a long term programme. As a preliminary it is hoped that we shall be able to gain information as to the effect of various manurial treatments on the mycorrhizal fungus and whether these effects are reflected in the general behaviour of the bush. Secondly, the clone 2024 well known to many of you as a good rooter, rapid grower, high yielder and, in addition, quite highly resistant to blister blight must be closely examined to ascertain whether the observed fungus growth is peculiar to this clone, or merely a response to the treatment received by the clonal rows. This treatment, in addition to normal fertilisers has consisted of liberal applications of grasses as thatch.

Although we have shown that the ectotrophic type of mycorrhiza of conifers is of definite benefit to the plant, and that the endotrophic type is significant in orchid culture, there is no evidence of an endophyte such as we are dealing with being of any benefit to crop plants. On the contrary, those examples cited suggest a parasitic relationship and we must bear this fact in mind. We must also bear in mind the fact that in all cited cases of mycorrhizal association whether beneficial or parasitic, the application of organic materials whether as composts, stable manure or green stuff, has undoubtedly benefited the host plant. Wight at Tocklai suggests, without evidence it is true, that the varying responses of tea to nitrogeneou manures under-different shade levels is a direct response by the mycorrhizal fungus to light intensity. This is most unlikely, but does help to indicate the wide scope of the work.

If we can show for our fungus (*a*) sufficient soil connection for it to aid in absorption, (*b*) nitrogen fixation or elaboration or (*c*) the provision of growth substances by its breakdown, then we can adjust our cultural operations to benefit our fungus, and thereby our tea. If all or any of these is shown to be significant, then I suggest that our answer will lie in the provision of very much more organic matter to our soils.

THE PRINCIPLES OF PEST CONTROL

(I). GENERAL

J. Lamb

As an introduction to this part of our deliberations I wish to make a few general observations about the control of pests and diseases, and to define our views on blister blight control in particular.

The success of the blister blight control measures we recommended at the last Conference has fully equalled, if not exceeded, our expectations. I now confess that when we published our recommendations we were exceedingly anxious about whether they would work out in everyday practice. Had they proved to be a failure in estate routine, we should have been placed in a very difficult position indeed. I, therefore, take this opportunity, not only for congratulating you, but also sincerely thanking you for the backing you have given us.

As we anticipated, the introduction of effective control measures have had a spectacular effect on the general incidence of the disease. Every single infection is a potential source of perhaps two or three million other infections ; for each blister produces that number of spores. Even in practice, the number of actual infections arising from a single source is very high, for, I would remind you, the disease from the time it was first detected, spread with lightning rapidity over the whole of the tea districts. I have even heard it suggested that the disease has lost its virulence. This is a very dangerous idea, for attacks still build up very rapidly when left unchecked. There is, unfortunately, no evidence of any kind to suggest any reduction of virulence.

It is, however, owing to the enormous reduction in the number of foci of infection, becoming easier to be misled by the *apparent* effectiveness of control measures. A high standard of work in the application of control measures must be maintained. There must not be any slackening.

We still advise the use of 4 ounces of 50% copper fungicides per 10 gallons of spray fluid and have not altered any of our ideas about rates of application, types of equipment, or spray nozzles. I have previously warned you about the dangers of experimenting with spray nozzles. I repeat that a spray nozzle is not merely a piece of brass with a hole knocked through it. Unless you carry out accurate experiments, backed by the necessary technical knowledge, you can be badly misled and my advice is to adhere to the recommendations published in our blister blight circulars.

It is becoming increasingly difficult to test and to approve all the fungicides and equipment now being offered to the industry. Our staff is not large enough to permit us to run a testing and approval section. It is a difficult situation, but it is no part of our duties to assist in the sales of any proprietary products and we can only agree to test those products which promise some decided advantage, particularly in the reduction of costs.

Hand dusting is proving a promising alternative to wet spraying and particularly offers scope for the extension of protective measures where shortage of labour limits the amount of spraying which can be carried out. 4% "Cuprosana" dust applied with hand dusters at the rate of 5 lbs. every five days has given consistently good

protection. 6% "Cuprosana" dust has given good protection to pruned tea up to tipping, after which a change to 4% "Cuprosana" dust has been satisfactory. We cannot at present recommend the use of smaller quantities of dust, but will agree that the *skilled* use of smaller quantities may prove efficacious. I mention "Cuprosana" dust specifically because of several formulations tested, it is the only one which meets all requirements in Ceylon tea.

There have been two main lines of investigation in seeking advances in chemical prophylaxis. The first has been to search for chemicals which will increase the periods of protection given by fungicides. It was, and is still, hoped that systemic action may be developed, but so far there is no progress to report. The second line of search was for improved methods of application. The Shell Company sent Mr. Van Bemmel to Ceylon in 1951 with a prototype portable mist blower which went through its initial trials on St. Coombs at the end of that year. Mr. Van Bemmel returned last year with improved models and co-operated with us in further tests, as a result of which a third model is now in production and we propose to carry out more tests this year. Using 6 ounces of Shell copper fungicides in a charge of 10 gallons of water, an acre of tea is given satisfactory protection. Each operator can handle ten charges in a day's work. As with dusting, therefor, each labourer can cover up ten acres a day, but at a much lower cost for fungicide. Our present opinion is that the scope for the machine is limited to its use in batteries with a mechanic/supervisor in charge.

Experiments with double nozzle and with power charging units have been promising but tend to increase the problems involved in the control of operations.

(II). THE USE OF INSECTICIDES

J. Lamb

Twice in recent numbers of the "*Tea Quarterly*" we have issued warnings about the indiscriminate use of insecticides. I only wish now, in the fewest possible words, to emphasise the importance of this warning.

Agriculture is in itself an interference with the balance of nature, and pests, diseases and weeds are all signs of *im*balance. Once a perennial crop, such as tea, is firmly established, some form of equilibrium in the insect population is established. Introduced pests are normally the greatest source of potential danger. Any really serious indigenous pest will usually prevent the establishment of a perennial crop, or make it uneconomic in the early stages of its history.

Interference with any indigenous pest, causing loss of crop but not making the crop entirely uneconomic, is fraught with great dangers, because the whole balance of the insect population may easily be upset. In deciding upon the use of insecticides the insect population as a whole, and not only the pest itself, must be studied. Many modern insecticides are very powerful weapons but none is capable of killing all insects. The use of one insecticide too often necessitates a follow up with another to control insects normally checked by predators which have been killed by the first insecticide. The expense of such a chain of operations can be very high indeed.

Further troubles are developing, for there are frequent examples of resistant strains of pests surviving the first control measures and breeding up to replace the susceptible strains of the same species thought to have been brought under control.

The study of insecticides is a highly specialized occupation and I urge you not to meddle with these highly dangerous substances.

III. WEEDICIDES

G. B. Portsmouth

Modern weedicides can very roughly be divided into three classes according to the nature of their action and the plants they are designed to kill :—

(1) Non-selective Contact type Weedicides

Sulphuric acid
Sodium arsenite
Sodium chlorate
"Atlacide"

D.N.O.C. (Sodium salt of dinitro-ortho-cresol)
Pentachlorphenol
"Kanex"
"Santophen"
"Santobrite" (Sodium salt).

Weedicides of this group are capable of killing almost all plants they can effectively "wet".

(2) Selective "Hormone" type Weedicides.

MCPA (Sodium salt of 2-methyl-4-chloro-phenoxyacetic acid)
"Phenoxylene"

2,4-D (Sodium salt of 2,4-dichloro-phenoxyacetic acid)
"Fernoxone"

Weedicides of this group are chemically related to the plant growth hormones and operate by penetrating the tissues and there setting up metabolic disturbances. They were chiefly developed for use against broad leaf weeds in cereal crops. They do not affect grasses and certain resistant broad leaf weeds.

(3) Selective "Grass" Weedicides.

TCA (Sodium or ammonium salt of trichloracetic acid)
"Tecane" (Ammonium salt).

IPC (Isopropyl N-phenyl carbamate).

Weedicides of this group have only recently been developed with the object of having a selective action against certain grasses. They will also kill many broad leaf weeds.

Although trials with all these different weedicides have been carried out from time to time, our most recent experiments have been designed to determine the effectiveness of TCA and IPC, either alone or in combination with other weedicides, against couch (*Panicum repens*), and illuk (*Imperata cylindrica*). Recent results indicate that at least three applications of TCA at a rate of 50 lbs. per acre are necessary to give a complete kill of either of these grasses. Combining TCA with other weedicides, cutting the grass before treatment, and or forking the area, did not apparently give any increase in effectiveness. IPC was ineffective in all strengths and combinations tested. When the present high cost of TCA per pound is taken into account it does not appear that the use of weedicides to control couch or illuk can be economical.

Sodium chlorate is perhaps so far the only weedicide which is of any economic value on a tea estate. Used at a concentration of 2 lbs in 10 gallons of water, and applied at a minimum application rate of 100 gallons per acre, it has proved quite an effective means of controlling the weed *Eupatorium riparium* in ravines and along boundaries.

Economics apart, the complete elimination of all weeds with one weedicide spraying would appear to be still only a pipe dream. Thus in our own experiments, whatever combinations of weedicides have been used, the weed *Commelina sp.* appears to have been completely unaffected. Accordingly the intensive use of one or more weedicides may be expected in the long run to produce the same effect as that of selective weeding—certain uncontrolled species may well increase and become new pest species.

Finally a most serious word of warning. Tea is affected by all the weedicides we have tested. In fact TCA has proved to be one of the most effective killers of tea that we know. In an experimental plot of pruned tea, in which TCA was sprayed against couch, all the bushes were soon dying as a result of the absorption of TCA through the roots. The buds first started to develop and then died off. Never, therefore, undertake any weedicide experiments in standing tea unless you have first obtained proper scientific advice.

IV. EELWORMS

C. A. Loos

The occasion of a general address provides me with an opportunity of surveying one of my particular interests in the wide field of plant pathology. My paper, therefore, deals with that branch of plant pathology known as nematology which is the study of nematodes or eelworms.

Eelworms are a self-contained class of the animal kingdom and are in a group apart, zoologically, from the well known earth worm, which is an annelid, or the wireworm which is a beetle larva. Eelworms are also known as roundworms and threadworms.

The group, as a whole, is of great medical and economic importance. On the medical side we have hookworm and filarial diseases, to name but two of the many diseases man and beast are subject to. Large numbers of workers are actively engaged in the study of these parasitic forms.

The study of free-living and plant-parasitic eelworms has not advanced to the same extent as the study of human and veterinary parasites though, in the last two decades, our knowledge of eelworms associated with agricultural crops has made some considerable advance.

Eelworms are one of the most abundant forms of animal life of soils in which organic matter undergoes decay. Most of these species are free-living or bacterial feeders, the other forms include parasites of plants and fungi and also predatory species which feed on other eelworms and small organisms found in the soil. The plant-parasitic species are fortunately few in number, there being between 50 and 100 species recognised as plant parasites. Of these, only relatively few, about a dozen species only, may be considered serious pests of agricultural crops.

The mouth and head structures of eelworms are adapted to the form of existence which the species leads. The bacterial and free-living species have simple oral ducts through which the small, soft-bodied bacteria are imbibed. The lip region of some

of these species carry curious ornamentations or structures. Predatory forms are either armed with teeth or denticles, as an aid to devouring their prey, or with a hollow protrusible spear which pierces the body wall of the prey and through which the body contents of the prey are imbibed. The plant-parasitic species are also armed with protrusible spears which are often basally knobbed and resemble a pin. The spear is inserted into the plant tissues and the eelworm feeds either from outside the root as an ectoparasite or the spear is used to aid entry of the worm into the plant tissues where it feeds as an endoparasite on the elaborated plant foods.

Eelworm Pests

The most important and harmful pests of agricultural crops are the sugar beet eelworm (*Heterodera schachtii*) ; the potato or golden nematode (*Heterodera rostochiensis*) ; the stem and bulb eelworm (*Ditylenchus dipsaci*) a pest of oats, clover, alfalfa and a number of other plants ; the root-lesion or meadow nematodes of the genus *Pratylenchus*, one of which is known to us as a destructive pest of tea and also the root-knot nematodes of the genus *Meloidogyne*.

The root knot eelworm

Infestation by the root-knot eelworm is easily recognised in the field from the characteristic galls or knots on roots of infested plants. The two green manure plants *Tephrosia vogelii* and dadap are highly susceptible to root-knot damage and so is seedling tea in nurseries. Until recently all members of the family *Heteroderidae* carried the generic name *Heterodera*. The root-knot forming species was known as *Heterodera marionii*, a name most of you are familiar with. In 1949, Chitwood (1) an American Nematologist, split up the genus into two genera. The cyst forming species, of which the potato eelworm and the golden eelworm are two members, retains the generic name *Heterodera* while the root-knot forming species revert to the fairly unpronounceable name of *Meloidogyne*. Our friend *Heterodera marionii* ceases to exist and we have a number of new species erected in its place. I have recently added to it with a new species from mature tea (2).

In my last Conference address (3) I sounded a note of warning on the continued use of root-knot susceptible green manures in mature tea areas. I had inferred, from the presence of root-knot damage in certain areas of mature tea, that a specialised race may evolve capable of attacking the major crop. I have now been able to prove that the mature tea eelworm is a distinct species, and not a specialised race evolved from the species which attacks *Tephrosia vogelii* and dadap. You may grow your Tephrosias and dadaps, if you can induce those plants to grow in the presence of the eelworm, without fear of setting up infestation in your mature tea.

The two known species of root knot eelworms of Ceylon tea plantations are *Meloidogyne javanica* (Treub, 1885) Chitwood 1949 of tea seedlings and certain other green manure plants (this specific name is subject to confirmation after more material can be examined), and *Meloidogyne brevicauda* Loos 1953, the pest capable of attacking mature tea.

In the case of the species which attacks tea seedlings we have the unusual feature of a plant which is highly susceptible to damage in the seedling stage but acquiring total immunity as the plant ages. No other crop is known to have a similar reaction. This unusual feature gives us the opportunity of using fairly clean material, for supplying fields, if the nurseries are disinfected by chemical means prior to the sowing of seed. I shall refer to this later in my address.

Meadow eelworm.

The meadow eelworm of tea has also changed part of its name. *Pratylenchus pratensis* is now known as *Pratylenchus coffeae*. We still have with us a relic of the old coffee days.

Meadow eelworm has, up to now, been reported from 48 estates situated in most of the Ceylon tea planting districts. I am confident that the distribution of the pest if far more widespread than records indicate. On a few estates the effects of the pest are causing anxiety.

The symptom of meadow eelworm attack is in the presence of fairly large patches of unthrifty tea which has a thin appearance due to a deficiency of maintenance foliage. Removal of such bushes often discloses an almost complete absence of the usual bunches of finer roots. The main root system is free of galling or malformation but if the bark is lightly scraped with a knife, from the root extremities upwards, dead brown areas or blotches may be observed. The presence of these dead areas together with the absence of finer roots on unthrifty tea is a suggestion of meadow eelworm attack. Peeling pieces of the bark or cortex from the junction between dying and healthy tissues and the examination of the undersurfaces of the peeled strips, under the low magnifications of a microscope, would reveal large numbers of the eelworm.

Control Measures

The problem of control of plant-parasitic eelworms and of our tea eelworm pests in particular divides itself into three general classifications :—

(1) Cultural practices. Crop rotation and the maintenance of high soil fertility.

(2) Chemical treatment.

(3) The selection and breeding of resistant or tolerant varieties of crop plants.

Cultural practices crop rotation.

This is not possible with our major crop which is a perennial plant but is possible with green manures, grown either as bush crops or low shade. If *Tephrosia* and dadap are so heavily infested as to cause death of the plants it is necessary to change to immune varieties such as *Crotalaria anagyroides* in place of *Tephrosia vogelii* and Albizzia or *Desmodium gyroides* in place of dadap. A period of a few years under the immune plants and Tephrosia and dadap may again be successfully planted.

The maintenance of high soil fertility.

Lindford *et al* (4) have shown that the decomposition of large amounts of organic matter in the soil was associated with reduction in numbers of root-knot galls on cowpeas grown as an indicator plant. Many years ago Dr. Eden (5) conducted a replicated experiment on St. Coombs in which plots had either no compost or compost added. The composted plots supported a fine stand of dadaps while the plots with no compost carried sickly plants, due to heavy root-knot eelworm damage. An estate in the Dimbula district used large amounts of compost, cattle bulk, etc., which were incorporated into a small area showing severe debilitation of tea due to meadow eelworm. That area, a year later, appeared healthy and in excellent condition in comparison with the untreated part of the field.

How does the maintenance of high soil fertility effect eelworm damage? Opinion on this subject is divided. Some workers consider that the incorporation of decaying matter into the soil increases conditions under which predatory forms of fungi, mites, insects and nematodes can thrive. Others consider that a healthy plant growing under fertile soil conditions can support large numbers of parasitic eelworms and still crop satisfactorily. There is much to be said for both opinions though the resulting benefit to the crop is the same in both cases. The crop yields satisfactorily.

I have often been asked, when I advocated the incorporation of large quantities of green matter to the soil, as a mulch or thatch, where the normal estate could find or grow the vast quantities needed. The answer is in your hands. The interplanting of green manures in tea will not alone supply the 15–20 tons of green stuff per acre required periodically to make thatching worthwhile. Is it preferable to expect 500 lbs. of tea per acre over say 500 acres, or 800–1000 lbs. per acre from three-fourths of that area ? The balance acreage may be used profitably to grow green material such as Guatemala grass etc., for thatching purposes. American farmers have answered the question themselves and many of them now grow sugar beets yielding higher crops over half the acreage of land they previously farmed.

Chemical control.

Almost without exception, for application over large areas chemicals toxic to eelworms have to be discarded due to high costs, injurious residues, toxicity to man and animals and toxicity to plants. Up to the present time two soil fumigants (Shell D–D and Dowfume N) and ethylene dibromide mixtures, are acceptable for large scale applications, though both are costly to apply, and toxic to living plants. They should only be applied in the absence of a crop and in soil which is of a suitable texture for effective fumigation. A single application over an acre, using 800 lbs. D–D gave a 50 per cent increase in yield and a 50 per cent kill of the potato eelworm as measured 4 weeks after injection of the fumigant. After a following potato crop, however, the eelworm population was as high, or higher, than on the untreated plots (6). 800 lbs. of D–D alone would cost over Rs. 900 and to that should be added the cost of application. Even then the 100 per cent kill we require for a permanent crop cannot be achieved.

On small areas such as nurseries fumigation can, however, be a worthwhile and routine practice. I have already mentioned that tea acquires immunity with age to the commoner species of root-knot eelworm which has often caused almost total failure of nurseries. Application rates of 400 lbs. D–D per acre on properly prepared beds which have been freed of stones and undecomposed organic matter should give almost total extermination of plant parasitic eelworms together with cutworm, wireworm, white grub and other injurious soil pests. The plants are able to establish themselves and pass the stage of root-knot susceptibility before the small proportion of eelworm larvae, which survive fumigation, can build up to numbers capable of injuring the crop.

For efficient fumigation the soil in the nursery should be moderately loose and free from clods, lumps and undecomposed organic matter such as the roots of the preceding crop. If cattle bulk or compost is to be incorporated into the soil it should be done before the fumigant is applied. The soil should be fairly moist and not too wet or dry. Mark the area lengthwise and crosswise with strings set 15 inches apart to form small squares like a chess board. Starting along one side make injections along the points where the strings intersect and on alternate lines midway between the intersection points. This method would stagger the injections in a manner giving the greatest amount of diffusion of the fumigant. The Shell Company of Ceylon loan injector guns for this purpose. The gun should be set to deliver, with 25 strokes of the plunger, one quarter of a pint of fumigant which is the application rate of 400 lbs. per acre. The injector tube should be set to introduce the fumigant 6 inches below the ground level and the plunger actuated once only at each injection point. Immediately after application the nursery should be lightly wet and lightly rolled to compress the soil surface, and then covered with old jute hessian or sacking which has been previously wetted, in order to hold moisture and to avoid evaporation at the surface of the soil. The area should remain undisturbed for a week or ten days to allow the fumigant to diffuse completely through the soil after which the soil should be dug up to release the fumigant. Treated areas should not be planted for at least 3 weeks after fumigation. A half acre nursery which is about the size of average nurseries on estates should cost less than Rs. 250/- for fumigation.

Selection & Breeding of Resistant & Tolerant Varieties of Crop Plants

Considerable research has and is being directed throughout the world in the selection and breeding of resistant varieties of plants to eelworm injury. Plants considered to be resistant may either be totally immune to attack or eelworms may enter the root but are unable to complete their life cycle in the plant. Tolerance constitutes the presence of the eelworm in the plant without noticeable effects of deterioration or loss in crop.

Investigations into resistance have met with some success both in Ceylon and other countries and it seems probable that the use of resistant varieties of plants is the most productive and economical method for the control of eelworm pests in the

future. The problem does, however, bristle with difficulties as resistance or tolerance to one species of eelworm does not necessarily infer immunity to infestation to other closely related species.

American nematologists have developed as alfalfa variety known as Nemestan which is resistant to the bulb and stem nematode and the oat variety S.225, raised by Prof. E. T. Jones, has been grown free of the stem eelworm by Dr. T. Goodey of the Rothamsted Experimental Station on a farm in East Hertfordshire, where susceptible oats commonly fail. Two varieties of bean are known to be resistant to the root knot nematode. Shalil peach rootstock is resistant to the root-knot species *Meloidogyne incognita* but not to *M. javanica* while the peach variety S.37 is relatively resistant to both species of that eelworm. Paradox, a cross between the English and black walnuts is proving a good resistant rootstock against the rootlesion or meadow eelworm in America.

From 1939 onwards Dr. C. H. Gadd made a large number of selections of tea bushes, apparently resistant to the meadow eelworm, in areas of heavy infestation on a Dimbula estate. Clones were established by vegetative propagation in nurseries and then in multiplication plots. The progeny from those mother bushes are now well established and in production. Unfortunately the mother or clonal bushes no longer exist as with a change of management valuable records and the means of location of those plants have been lost. We are now unable to work back to those original selections, made 12–13 years ago, to find out how those clonal bushes have continued to react with time and in the presence of continuous heavy eelworm populations. Progeny from a few of the selections show obvious signs of deterioration while others grown in close proximity to them continue to flourish and crop satisfactorily. Those plants will supply valuable material for future investigation.

Other estates, too, are co-operating in the selection of high yielders growing in the midst of severely debilitated tea. I hope that the pooling of such material will eventually supply the needs of those eelworm infested areas which eventually become due for replanting. The policy is a long term one as much work has still to be done before material can safely be passed as suitable for large scale replanting. We have still to ascertain if resistance or tolerance is of short term duration and whether growing wholesale one type of material can be negatived by the evolution of a specialized race of the pest capable of breaking down that resistance or tolerance. Up to recent years we had heard a lot on specilization but it is now becoming increasingly apparent that what was considered a specialized race may in reality be a closely related but distinct species. If that is the case our chance of success is very encouraging.

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THE PRINCIPLES OF BRINGING NEW CLEARINGS INTO BEARING IN THE LOW-COUNTRY

T. E. Walter

I have chosen as the subject of this paper " The Principles of Bringing New Clearings into Bearing in the Low-Country " as this appears to me to be not only one of the most important matters in the low-country, but also one of the most controversial ones. Moreover, taking the long term view, it is no exaggeration to say that the type of frame subsequently developed, and hence the shape, spread, yield and even the life span of the tea bushes is dependent to a very large extent on the treatment they receive in the first few years of their lives ; apart from these far-reaching effects, the immediate advantages to be gained by bringing new clearings into bearing in the shortest possible space of time should be obvious to everyone.

Before considering the practical details of each method, I will just outline briefly some of the main principles involved. All the various methods and their variations fall naturally into two main groups — namely, those in which the knife *is* used, and those in which it is *not* used. In deciding between these two groups, the principal points at issue are :—

(1) Is there any relationship between the method adopted and the incidence of shot-hole borer ?

(2) Is the incidence of wood-rot likely to be affected ?

and (3) Are the subsequent frames and number of flushing points (and hence yields) comparable ?

With regard to shot-hole borer incidence, Mr. Austin has made some preliminary counts which tend to support the view that in the districts where shot-hole borer is serious — and this applies to nearly all the low-country districts above about 500 feet — the incidence in new clearings is at the worst from about the third year onwards, regardless of whether the plants have been centred or not ; no comparative figures are, however, available and detailed information on this point will be collected this year.

Regarding the incidence of wood-rot, the story is very different. Although wood-rot is likely to remain one of the most serious problems in the low-country, owing to the necessity for the periodical pruning of tea bushes,its incidence can be controlled prophylactically, and in particular by avoiding the use of the knife as far as possible.

In further explanation of this, I would point out that all exposed unprotected pruning cuts form ideal points of entry for numerous wood-rotting fungi. If the cut is in thin wood, there is a good chance that callus growth will cover the cut surface before these wood-rotting fungi can do any damage ; cuts into thick wood, however, naturally take very much longer to callus over and even if they do subsequently heal over perfectly (which usually they don't) it is quite likely that the fungi have not only already gained entrance but started active growth ; in this case nothing can be done to stop their slow insidious spread in the interior of the stem except to remove the affected portion by a further cut lower down the stem, with further obvious disadvantages. In view of the fact that in the operations under review the main stem

of the tea bush is concerned (as opposed merely to a branch) we feel justified in opposing on principle the use of the knife in new clearings on all wood above, say, the thickness of a thin pencil.

The third point I raised, namely, are the subsequent frames and number of plucking points (and hence yields) comparable, brings me to a rather more detailed description of the various systems now in common use.

Considering first the low secateuring method, this usually involves making 4 cuts at intervals of 9–12 months — typically at 2", 4", 6" and 10". Although the secateuring method (by which the stem is cut half or three-quarter way through only) is a considerable advance on the old time " clean centre " in that the risk of casualties is not nearly as great, it nevertheless does involve exposing thick wood, which, in the fast growing high rainfall areas, is often as much as an inch in diameter. The risk of fungal infection on those exposed surfaces can be minimised if they are painted over immediately with a special durable preparation (such as pruning wax), but I have yet to see any new clearings where this precaution has been taken. Also it inevitably means that the entire growth put on the previous year — often as much as 5–6 feet high — is lost, although of course its maintenance functions are utilised temporarily towards the development of new shoots. The result is that bushes treated in this way are not usually brought into bearing inside 4 years, and sometimes even 5 years ; it cannot be denied, of course, that a low branching habit is induced, and an estate in the dry zone where this method is adopted reports yields of 186 lbs. in the fourth year, rising to 931 lbs. in the fifth.

Before leaving this subject, I would just like to show this photo of wood-rot, (not illustrated) though I hasten to add that it has not necessarily developed to these proportions solely as a result of a low centre in its youth. Other things have, of course, contributed to it — for instance it was probably collar pruned at some time in its life — but it does illustrate the damage that can be done by wood-rot right down in the main stem. Note that even at this stage it is still supporting a number of miserable branches round the periphery, but such bushes are of course nothing more than moribund passengers.

A recently developed modification of this system appears worthy of trial — namely to ring-bark the stem at about 2" from ground level. The few plants I have seen treated in this way had reacted by throwing out numerous low side branches very quickly, and moreover the inch wide ring had completely callussed over from top to bottom, rendering the severance of the original portion unnecessary.

Another variation is to dispense with one or more centerings, depending on the number of branches that have already been induced — this having the obvious advantage of shortening the time required to bring the bushes into bearing.

Coming now to the other series of methods by which new clearings are brought into bearing without the use of the knife. These methods have the great advantage that there is no set-back in growth and no wastage, so that bushes can be brought into bearing in 2½ to 3 years, which represents a very considerable saving in time and money.

Considering firstly the method known as " layering " pioneered and developed by Mr. Bean of Ederapolla Estate ; in this system (Fig 1) the young plants are bent over when they reach pencil thickness *i.e.*, at about a year or 18 months old ; the bark on the underside at the point of layering should be scraped so as to stimulate root growth, and the ground lightly forked ; the layered stem or branch is then covered with earth for several inches, and held down by a forked stick or two crossed sticks. If this is done correctly, a very rapid growth of new shoots is induced along the stem, as well as a dense subsidiary root system at the point of layering. The

Fig. 1.

Fig. 2.

PLATE 1

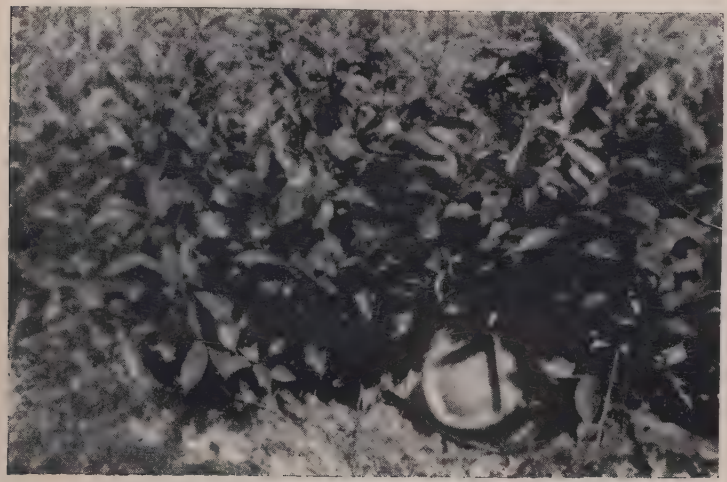

Fig. 3.

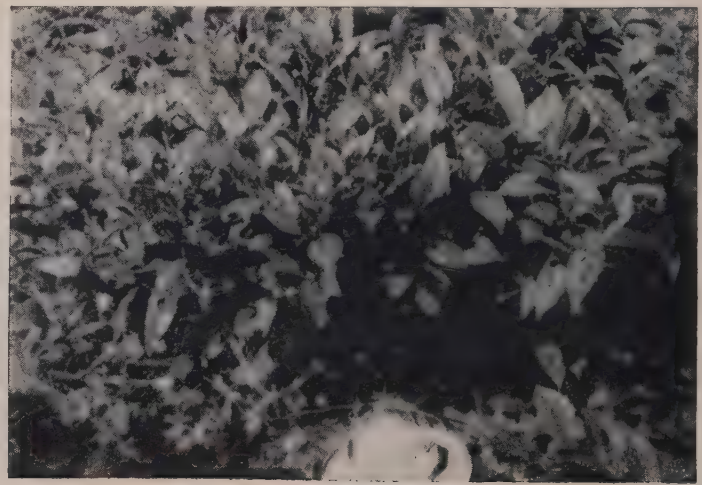

Fig. 4.

PLATE 2

Fig. 5.

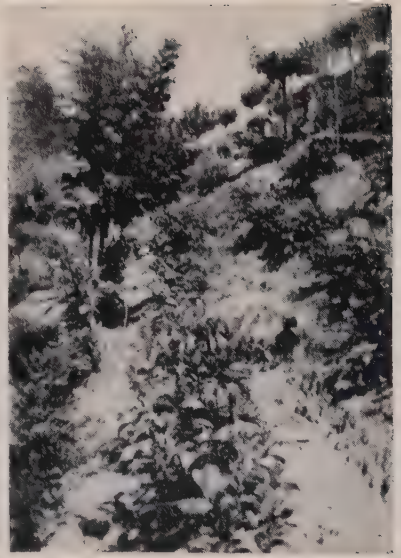

Fig. 6.
(Left.)

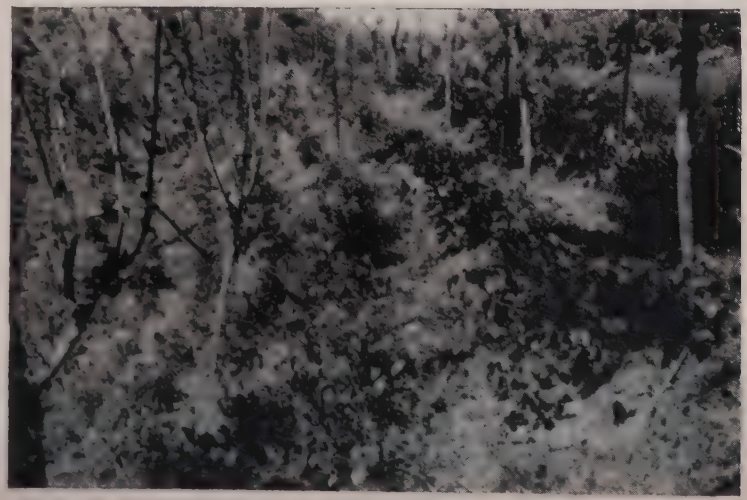

Fig. 7.

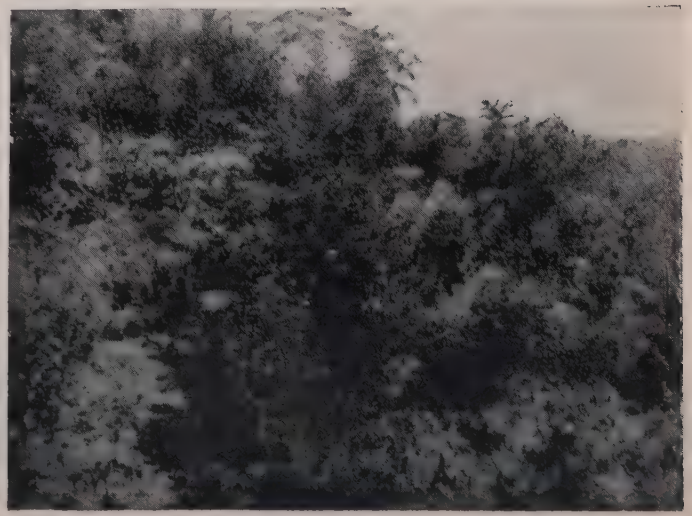

Fig. 8.

Fig. 9.

Fig. 10.

PLATE 3.

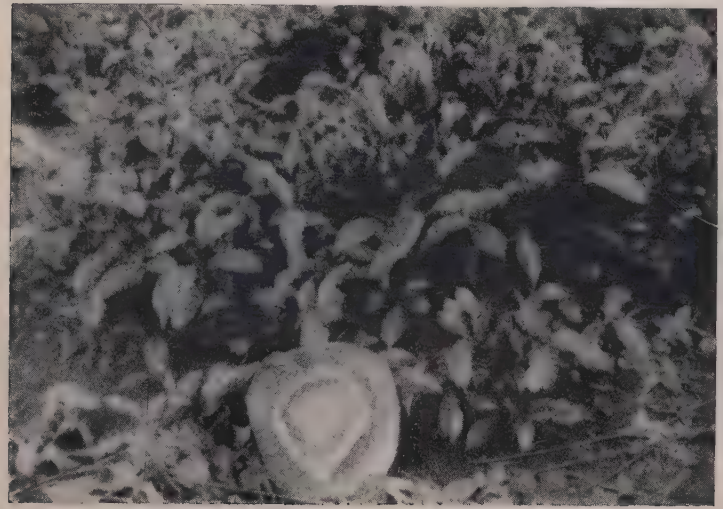

Fig. 11.

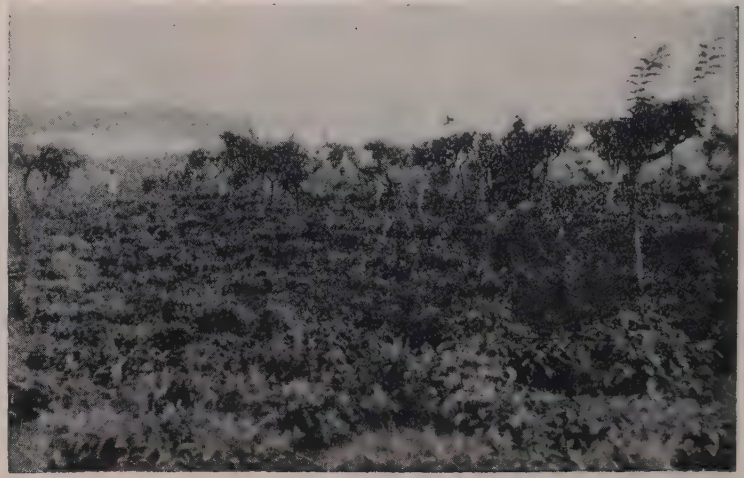

Fig. 12.

PLATE 4.

Fig. 13.

Fig. 14.

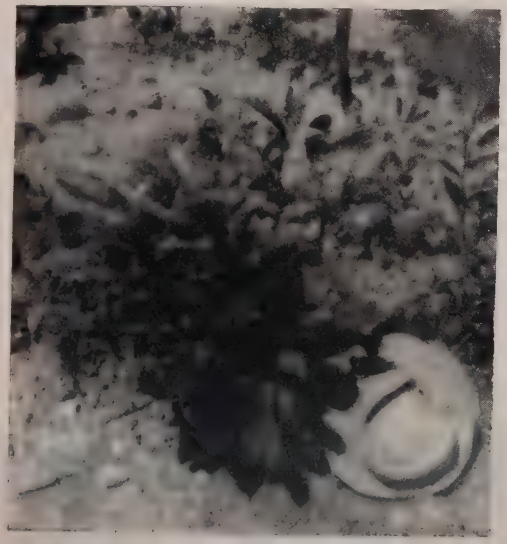

Fig. 15.
(Left.)

Fig. 16.

intention is not, however, to produce a separate plant, so the portion beyond the point of layering should on no account be cut off, as it will not develop properly as a separate entity.

At the next stage, 6 months later, there is a choice of two operations — either low cut-across or, preferably, a second layering and this photo (Fig 2) shows the dense continuous mass of shoots produced by a second layering (in herring bone fashion) which also helps to increase the lateral spread.

The final stage occurs at about 28 months (Fig 3) when the bushes are ready to receive either a cut-across at 10″, or alternatively they may be merely tipped at 12″–15″. At about 30 months they are brought into plucking and here (Fig 4) is a typical bush from the 1948 clearing — *i.e.*, $4\frac{1}{2}$ years old — showing some of the shoots developed by layering now thickening up into a good sturdy frame.

The next photo of a 1948 V.P. clearing (Fig 5) illustrates the very fine cover of tea that can be produced ; actual yield figures for this field are as follows — 3rd year (*i.e.*, 30–42 months) 425 lbs. per acre ; 4th year 535 lbs. per acre (seedlings) compared to 690 lbs. per acre (V.P. area) ; while in the current year 11–1200 lbs. per acre are confidently expected (at least from the V.P. area).

This method is applicable to a wide range of low-country conditions, but it is pre-eminent on steep slopes where the hedge type of formation produced forms such an impenetrable barrier to soil erosion that a series of terraces are built up in a remarkably short space of time. This photo (Fig 6) shows a 1950 clearing where the soil was fairly good — already the natural terraces are forming, and the next photo (Fig 7) shows a 1948 clearing on very poor soil, where the terraces are by now well formed.

An interesting development of this technique is now being tried — again by Mr. Bean — on an area of old tea (Fig 8) previously yielding only 300 lbs. per acre. Rather than abandon this area entirely, it was rested in February, 1951 and layered in October 1952, (Fig 9) making use of whatever good, red wood had developed in the meantime. It was re-supplied at the same time, but the soil is so poor that only about 30% were successful ; it will of course, be some time before the success or otherwise of this type of experimental layering can be assessed, but it shows promise and may well be a sound method of saving areas with marginal yields from complete abandonment, or serve as an alternative to replanting.

The next method, pioneered and developed by Mr. Perkins of Rye Estate, consists in bending over and pegging down the plants flat on the ground, when they reach pencil thickness. Again, a phenomenally rapid and abundant growth of new shoots comes away — a factor of great importance in V.P. multiplication plots ; If care is taken to get the stems absolutely flat on the ground and not " looped " the new shoots definitely tend to concentrate at or very near the collar, as shown in this photo (Fig 10) of a December 1949 bush (*i.e.*, just 3 years old). In fact this tendency was so marked on some of the fields examined on Rye that I was tempted to suspect that they must have been secateured, which I was nevertheless assured had not been done. Note also the original bent over stem on the left — no sign of it atrophying, and although some planters prefer to have this part off there does not seem to be any point in removing it. The next step, at 24–28 months is a cut-across at about 15 inches, and the bushes are brought into bearing at about 30 months. This photo (Fig 11) shows a more typical bush from the same clearing (*i.e.*, just over 3 years old. The next photo (Fig 12) gives a general view of the December 1949 clearing, just coming into bearing at 3 years, having received a serious setback owing to the drought last year.

Fig 13, of a bush just over 4 years old, shows the type of development that can result from this treatment ; note particularly the thick well-developed

spreading frame, most of whose branches originate at or near the collar. The next photo ((Fig 14)) shows a general view of the same clearing (*i.e.*, December 1948), whose yields were as follows :- 30–42 months, 415 lbs ; 4th year, 350 lbs. (a serious drought year) and 5th year confidently expected to yield 1,000 lbs. per acre if weather conditions are normal ; judging by the fine continuous sheet of tea, this estimate appears fully justified.

I now come, lastly, to the method known as " thumb-nail " pruning. As its name implies this method involves typically the breaking off of the tips of the young shoots, or at the most a cut into wood of thin pencil size. It is open to several variations as follows :—

(1) The tips of the young plants are pinched off at 3, 6, and 9 months, typically at 4", 6" and 8". The bushes are then either rested for the next 2½ years or so to allow the frames to thicken up or the " pinching off " process may continue — this of course amounting to a light pluck, from which purely nominal yields are obtained. In the Kandy district, where this system finds favour, the bushes are ready for a cut-across at about 3 years and the 1946 clearing shown in this photo (not illustrated) yielded 520 lbs. in its 4th year and 785 lbs. in its 5th year.

A slight variation now adopted on this same estate involves giving only one thumb-nail prune at 18", when the bushes are 24" high ; this represents a considerable saving in labour, and appears to give comparable results.

(2) The other main variation involves " pinching off " the tips of the plants at about a year old (taking care to leave 4–5 leaves), and here we see (Fig 15) a well-branched plant 18 months old on an estate in the K.V. just about ready for a centering at 10". At about two years old another centering is given at about 14", and at 2¼ years — the stage shown in the photo (Fig 16) — the bushes are ready for tipping. No definite yield figures are available for this method, but a yield of 5-600 lbs. is anticipated in the first year of plucking in the 1950 clearing shown — plucking starting at 28 months.

I would add that the " thumb-nail " pruning method is the one that should be adopted when making a preliminary selection of V.P. clones, since only by this system can the natural branching characteristics of each individual clone be assessed. Should it be desirable to retain poor branching clones, or should some seedlings fall to respond to " thumb-nail " pruning, " bending-over " usually produces the desired results.

I would emphasise, in conclusion, that none of the yield figures given for the various methods are strictly comparable, since they have of necessity been collected from estates in all parts of the low-country ; they do, however, provide some indication of the results that can be obtained with each, and the question of which is the best I leave to your own judgment.

VEGETATIVE PROPAGATION IN RELATION TO THE REPLANTING OF POOR YIELDING AREAS

J. O. Widdows

I have been asked to give a brief talk to you to-day and to give you my experiences, in the hope that it may help some of you who have taken or contemplate taking up vegetative propagation as a means of *replacing* old or poor yielding areas. I stress the point " *replacing* old or poor yielding areas " as I do not wish to say anything regarding the question of using vegetative propagation as a means of supplying individual vacancies in tea.

In 1946, Ottery Estate had in mind a long term policy of the replacement of poor yielding areas and, in consequence, when opportunity permitted, certain bushes were selected as mother bushes. Over the whole estate, some 30 such bushes were selected and the business of pruning, checking for yields, quality of manufactured teas etc., was put in hand.

Shortly after having made the selection, blister blight made its appearance and, in consequence of this, after a lapse of time, further selection was of course made very much easier. Bad subjects to blister blight were automatically rejected. I will however refer to this matter later on.

Having made an initial selection, the question of poor yielding areas and the treatment of such areas had to be decided upon, bearing in mind the fact that the policy was a long term one and that eventually all poor yielding areas would be replaced by good yielding clones.

It was decided, therefore, that in the first instance an area of roughly three acres should be uprooted and the reconditioning of the ground put in hand. This work was commenced in July 1947.

The uprooting was then rather a laborious and costly business as the bushes were removed by hand. This is a different matter now as the bushes are removed by a mechanical grubber and the cost of uprooting has, of course, been very considerably reduced.

The tea having been removed over a 3 acre area, the reconditioning of the ground was the next consideration and as a means of doing this the area was first re-drained and re-roaded, where necessary. Incidentally, the drains were entirely re-cut. They were cut at a slope of 1 in 120, the bund principle being employed as against the pit — 3 foot bunds being placed at intervals of 15 to 20 feet. This having been done, the area was planted up with a legume and *Tephrosia vogelli* was broadcast throughout. Thatching was also done as a means of re-conditioning the soil.

Meanwhile, the testing of the clones had been going on and, owing to blister blight and other causes the original 30 or so mother bushes had been considerably reduced. There were various causes which accounted for this reduction, such as (*a*) poor yielders (*b*) poor liquoring teas (*c*) slow and bad rooters in the nursery (*d*) bad blister blight subjects etc. It is perhaps advisable to point out that, after pruning the mother bushes, they were allowed to return to the tipping stage, after which tests

were taken for yield and quality of teas. This having been determined, cuttings were taken and planted out in the nursery. The next step was the selection and construction of a multiplication nursery.

As pointed out previously, one of the reasons for the rejection of some of the mother bushes was — *slow and bad rooting*. This was very soon manifest in the nursery beds. Poor yielders were, of course, not given the chance to show their paces in the nursery and were discarded before cuttings were taken.

Likewise " bad tea makers " were discarded, it being an obvious waste of time to persevere with them. In this connection it is perhaps of interest to know how the leaf from any particular mother bush was tested for quality. For the purpose of rolling, a small roller with a 3" " box " was made by the estate baas and for firing a small cage made of fine brass mess, which could be turned by a handle. This was placed into one of the inspection holes of the ECP and turned by hand to keep the tea moving. Both these home made make-shifts worked quite satisfactorily then and produced teas which, although perhaps not all that one could wish for, were good enough for the Colombo taster to make a fair report on and to give an idea as to whether the particular clone was worth persevering with or not.

The first lot of cuttings were transplanted into the multiplication nursery. After these had been established, work on the supplying of the up-rooted area was started. Needless to say, planting was on the contour system, plants being spaced at 5 ft. between rows and 1½ ft. along rows.

In every case, cuttings have been transplanted by means of the Hersall Transplanter and results could not have been more encouraging.

The first plants were transplanted in December, 1949 and since then there has been steady progress until to-day. It is estimated that some 5 or more acres have now been planted up. This expansion has of course necessitated the clearing and grubbing up of further areas and in consequence 1½ acres was grubbed out in 1951, 1½ acres in 1952 and further 1½ to 2 acres have just been completed this year.

As time goes on, the speed of expansion must of course increase as cuttings from clones in the multiplication nursery come into bearing. This is actually happening now. In this event, the necessity for nursery space becomes apparent and this naturally depends on the area available for making nurseries. If space is restricted as it is on Ottery, one must look for other outlets and this has been overcome by the method of planting cuttings direct into holes in the clearing. By this means, 3 cuttings are planted into one hole and considerable success has been achieved. If two or three cuttings survive, the extra one or two can of course be transplanted when big enough. In this connection I would stress that the watering of these cuttings during drought periods is absolutely necessary. This has been achieved by means of water supplied by a ram pump.

It has been found that during monsoon months, it is advisable to plant cuttings into nursery beds where they can be better attended to and the possibility of cuttings dying through " wet feet " is not as liable to occur as when planted direct into the holes. Direct planting should therefore cease say in April/May and start again in Sept/October.

In the case of individual transplanting, all plants have been protected by a protection basket and lightly shaded with " Meena pillu." Where cuttings have been planted direct, three to a hole, old plucking baskets have been cut into two or three and used as a protection. In cases where this has not been possible, shade fern only has been used. The incidence of " die-back " has been very small indeed and this is attributed to the fact that the plants have been protected. In nearly all cases of " die-back," the cause has been due to the ringing of the bark at ground level, this being done by fine particles of top soil having been blown against the bark by strong winds.

I mentioned earlier that the first plants were planted into the clearing in December, 1949 and it will no doubt be of interest to know that these are now in plucking, light plucking have been undertaken in the first instance in November last year, just 35 months since they were transplanted. It goes without saying however that regular manuring has not been overlooked and for this purpose "Black Label" sterilised animal meal has been applied at six monthly intervals. The dosage has of course been progressive according to the age (in years) of the plant. It is, I think, advisable to point out that this organic fertiliser does not produce flush but is initially a frame and root builder and care should therefore be taken to switch over to a flush building mixture well before one expects the bush to come into light plucking.

It is natural to expect that the progeny of the mother bush should, as time goes on be true to form and, in this respect there has been no disappointment on Ottery. As stated before, there have been many rejections of mother bushes until to-day, six main clones are relied upon.

Now comes the question as to whether or not, yields and tea making factors have been maintained in the progeny. The answer to this is a very emphatic "Yes." In so far as the former is concerned, it is of interest to note that during November and December last, the equivalent of 600 lbs. per acre per year of made tea was yielded from the 1727 bushes which were in plucking — plucking having been commenced on November the 11th.

As to the resultant teas, the reports on them from Colombo has been most encouraging. I quote from an instance — "I have just examined the clonal samples and I must say they are the most successful natural manufacture on a miniature scale that I have seen. The make is far above the level of the usual clonal samples. As regards the teas themselves, I consider that No. 3 is a really excellent bush. There is fair colour in the liquor with excellent quality and some flavour. The infusions are bright and even." That, I think you will agree, is at least encouraging.

Now, in so far as miniature manufacture is concerned, I suggest that one can make the necessary equipment on the estate without much trouble or expense and, in order to substantiate this, statement, I have put on view here, a small roller with an 8" box, and a small desiccator. Both these were made on the estate. The only material bought outside in the case of the roller was the crown and pinion wheels and the small length of shafting. The rest was found on the estate. In the case of the desiccator, the material is practically all bought but, in any, event the cost of this was only in the region of Rs. 175/–.

The foregoing will, I hope give you some idea of the merits of a long term policy of rescusitation of poor yielding areas.

I leave the rest to you.

TENTH BIENNIAL CONFERENCE

CHAIRMAN'S SUMMARY

So, Gentlemen, we come to the end of the second session of this tenth biennial Conference.

To sum up the subject matter put forward by the respective speakers is rather an onerous job, particularly for one who has attained my age ! You have demonstrated your close attention to the papers that have been read, and on your behalf and mine I express our thanks to the several speakers for the trouble they have taken and for the manner in which they have presented their papers.

This is the third Conference at which I have had the honour to preside, having been Chairman for over eight years. One thing that has impressed me is the fact that, ever since these Conferences have been held, the attendances have been most encouraging — first for those that were held at St. Coombs and subsequently at Kandy and on the last two occasions in Nuwara Eliya. This indicates, I feel assured, the confidence those responsible for the Tea Industry have in the research carried out by our Institute and the recommendations emanating therefrom.

At the last Conference I mentioned how grave would have been the position when blister blight struck Dolosbage in 1946, had not the Institute been in existence to tell us much about the pest and the application of copper that would be necessary to control it. Incidentally I would remind you that our Institute made the discovery that the blister blight spores make their entry from the top of the leaves and not from the underside as was thought to be the case previously. It is fortunate that the fungus attacks only young leaves, whereas the fungus '*Haemilia vastatrix*' that devastated coffee attacked both the old and young leaves.

I am pleased that the Director in his address 'The Work of the Institute' has sounded the T.R.I. Trumpet in respect of the Institute's success with their recommendations as regards blister-blight and, earlier, tortrix ; but I make emphasis of the fact that much other work has been done and results achieved, which are not so spectacular and is continuing. By what the Director told us, you will be conscious of the fact that research work has suffered severely for the reason that far too much of the time of the Senior Officers has been taken up with work of an administrative and advisory nature.

So it is that I am sure you will associate yourselves with me in expressing the hope that the Tea Research Institute of Ceylon will continue their research and the benefits to be obtained thereby for the advancement of the Tea Industry.

To enable them to do this further income is necessary, for our funds are at a low ebb and the cash reserves nearing exhaustion. I trust it will be the case that the Board will agree to recommend an increase in the rate of cess in the near future, and, thereafter, that additional funds will be available before many months are past. Your unanimous support of such addition gives us the assurance, if such is needed, that the members of the planting fraternity are squarely behind us.

If this is forthcoming, we shall be in a position to engage two more senior scientists, one in the Pathological and one in the Bio-chemical departments. Thus our Institute will attain more closely to its status when Drs. Eden, Gadd and Tubbs — scientists of outstanding ability — were with us.

I express our thanks to Messrs. Harrisons Lister Engineering Coy., Ltd. for the loan of the fluorescent lighting ; the Manager for the use of this convenient hall ; to Mr. Van Bemmel for the loan of his mist blower, which may result in greater economy in spraying, and to the Ceylon Tea Propaganda Board and to Mr. de Mel in particular for the excellent service of tea during the intervals.

And now I come to my last most important duty namely that of expressing our thanks to the Director, Mr. Lamb, his senior and junior staff for the excellent arrangements they have staged for this Conference, not forgetting Mr. Loos who was responsible for the production of the slides which illustrated the papers.

(END OF CONFERENCE PROCEEDINGS).

THE FIELD STALK CLIPPER

(By kind permission of the Scottish Tea & Lands Co. of Ceylon, Ltd.)

A. E. Richardson

It is generally agreed that good tea is made in the field although manufactured in the factory, in other words, good, short leaf as opposed to lengthy stalky leaf produces better quality teas. This can be established by comparing tea manufactured from 7 day plucking rounds with 14 day rounds.

In Uva some 50% of the annual crop is harvested during March to June and even with a balanced labour force of 1½ labourers per acre, plucking rounds often average over 14 days resulting in excessive stalk and fibre in the made tea. It is apparent that stalk contains little or no value and tends to cause uneven withering, rolling and firing apart from a poor appearance.

To endeavour to eradicate stalk in the course of manufacture is only to rectify a fault in the field. Careful observation will show that during the course of plucking and manufacture, the only time that all the stalks are end for end in the plucker's hand is just before he or she throws the green leaf into the plucking basket ; this would, therefore, appear the most opportune time to eliminate stalk.

The fullest advantage of this fleeting, but important, moment can be taken if the plucker is equipped with a device for clipping off the stalk before she throws the leaf into the basket, provided, of course, that sufficient freedom of movement is ensured so as to make the action swift and easy. The stalk clipper is designed to provide the plucker with such a device.

Suspended from the waist by a chain, it can be brought into use by a simple action. The plucker, after collecting two small handfulls of leaf transfers the leaf in her right hand to the left, and with her now free right hand takes up the clipper and trims off the stalk from the handful of leaf held in her left hand before throwing the leaf over her shoulder.

This implement has been in use on Brookside from January to April 1953, and my findings over that period are summarised below :—

Plucking

The plucker soon gets accustomed to using the clipper and trims off the green stalk as required. It is practically unbreakable and seldom requires sharpening. It can be put to good use in the kitchen which is another reason for its popularity with the plucker.

The dry weight of the stalk so picked off is not likely to exceed the weight of the reds normally picked out in the factory.

The time taken in clipping off the stalk may easily be set off against the normal picking over time at weighings, amounting to approximately 1½ hours per day, since clipped leaf will not require this attention.

Manufacture

Grading.—The improved standard of green leaf as the result of clipper plucking, caused a less quantity of low grades as may be seen from the following table giving the results of a test carried out in March 1953 :—

Process	*Date*	*B.O.P* %	*B.O.P.F.* %	*B.P.* %	*Other grades* %	*Total*
Normal Plucking	March 1952	59.95	12.27	7.14	20.64	100
Clipper Plucking	March 1952	73.78	11.82	2.71	11.69	100
Difference		13.83	–0.45	–4.43	–8.95	

Red leaf picking.—During March 1953 one division was clipper plucked and the other divisions normally plucked. As the table below shows the former tea cost 54% less to pick out.

Process	*No of red leaf pickers*	*Cost of red leaf pickers*	*Weight of reds in pounds*	*Tea manufactured pounds*	*Cost per lb. (cts.)*
Normal Plucking	363	Rs. 726/–	343	92,419	0.79
Clipper Plucking	59	Rs. 118/–	55	32,363	0.36
Total	422	Rs. 844/–	398	124,782	0.68

Prices

The first invoice of all clipper plucked leaf arrived in London in late March 1953 and was reported on as follows :—

Dry leaf.—Leaf is blacker, more even in make and contains distinctly less stalk than last invoice.

Liquor.—Liquor is not as strong as the last invoice, but shows an improvement in quality, pungency and brightness and has preferable flavour in the cup.

Infused tea.—Brighter.

It would thus appear to be more beneficial from all points of view if stalk were eliminated in the field rather than in the factory and the possibility of improving quality should weigh strongly with producers faced with the highly competitive world market conditions today.

REVIEWS

"Tea Pests and Diseases and their Control" by Ernest Hainsworth, formerly Plant Pathologist to the Indian Tea Association—Cambridge. W. Heffer & Sons, Ltd., 18/- net. (Rs. 12/00).

"Of the writing of books there is no end" wrote the sage philosopher of the Book of Ecclesiastes over 2000 years ago, and book writing has continued ever since at an increasing rate, accelerated by Caxton's invention of the printing press. Very many of these books were quite unnecessary and not worth the materials they were printed on, but the compilation of scientific works and, particularly those dealing with the diseases and pests of economic plants, is fully justified and of the utmost importance both to the grower and the plant pathologist.

Unlike Aristotle's works the modern scientific texts soon become out of date, partly on account of the rapid increase of new knowledge regarding the older known maladies, some of which became less serious, and partly because new diseases arise, sometimes with alarming suddenness. The unexpected outbreak of blister blight in Ceylon is a case in point. This disease has been known in Assam for very many years, but in 1946 it appeared without warning in Southern India and reached Ceylon where it spread with great rapidity throughout the tea growing districts of the Island.

The authoritative work on tea is Petch's "The Diseases of the Tea Bush" published in 1923 containing Petch's own investigations in Ceylon, and also accounts of diseases and pests occurring in other tea growing countries. At that date there was no one else so well qualified to write such a work about the diseases of tea in countries other than Ceylon. Since then Tunstall of the Indian Tea Association at Tocklai has produced some exceedingly useful pamphlets beautifully illustrated with coloured photographic reproductions of root and stem diseases (Memoranda Nos. 8, 1940 and 16, 1947) as they occur in North East India.

The title of Mr. Hainsworth's little book is misleading as is also the paragraph on the inside of the dust cover, which states "this unusually clear and complete handbook will prove indispensable to every tea planter". If "in North East India" had been added one would have no cause for complaint. However, Dr. H. H. Mann has made this clear in the first lines of his "Foreword," but as people are inclined to skip "forewords" and "introductions" these days, the Ceylon planter and probably those of countries other than North East India may be surprised at some of Mr. Hainsworth's statements. The diseases of a crop differ considerably in severity and incidence in different countries and what applies to North East India is not necessarily true to Ceylon, East Africa or New Guinea. On page 65, for instance, Mr. Hainsworth states "there are two main periods of the year when attacks (of blister blight) can occur on plains tea, late autumn, that is November and December, and spring, that is late March, April and early May." This certainly does not apply to Ceylon, nor do the control measures (pp. 65). Fortunately on page 118 there is a memorandum from the Tea Research Institute of Ceylon referring in some detail to the measures adopted in Ceylon for the control of blister blight by spraying with copper fungicides, though no indication is given as to dates of application.

The account of root diseases is perhaps the most useful in the book as these diseases seem to be very similar in both countries, but the Table on pp. 36 headed "Diagnosis of the cause of death of tea bushes" is not very clear, and a planter of any country other than North East India might be mystified by some of these diagnoses,

e.g., under " Symptoms " occurs " bark damaged by hail, cuts, abrasions or bark eating insects " and in the corresponding column headed " Disease " is *Nectria*, followd by " Stem disease " as the " Cause of death." In the same table *Poria hypolateritia* is given as a stem disease ! The two supplementary tables of secondary and primary root diseases quoted from Sarmah (pp. 37, 38) are excellent.

On page 18 we read of the shot-hole borer (*Xyleborus fornicatus* Eichoff) that " these beetles very occasionally have been reported to damage living bushes by girdling branches," and that " control measures are not normally needed against this curious pest." In the Uva Province of Ceylon this " curious " insect causes serious losses annually and so far it has not been found possible to devise adequate means of control.

For tea planters in North East India Mr. Hainsworth's little book contains much useful information and practical advice which, however, is scarcely applicable to tea in any other country. The book is well illustrated with photographic reproductions which would have been improved had the scale of magnification been indicated, *e.g.*, to the uninstructed, Thrips would appear to be about the same size as the leaf on which it feeds (fig. 22, opposite page 88).

As far as the diseases of Tea in Ceylon are concerned the planter's interests are the special care of the Tea Research Institute which is pursuing a vigorous campaign of investigation and research in tea pests and diseases. It has also published an up-to-date and adequate series of Monographs on Tea Production in Ceylon of which No. 2 " The Commoner Diseases of Tea " by C. H. Gadd, is especially useful. These, if read in conjunction with the articles which appear from time to time in the "*Tea Quarterly*," supply practically all the Ceylon planter needs to know.

W. J. D.

" Wild Flowers of the Ceylon Hills "

by T. E. T. Bond—Oxford University Press, Madras (Rs. 10.00).

Dr. T. E. T. Bond's keen interest in wild flowers will be familiar to everyone who came into contact with him while he was on the staff of the Tea Research Institute. In writing the present book, after returning to the U.K., Dr. Bond has made his wide knowledge of Ceylon's hill flora available to us all.

The book gives detailed descriptions and illustrations of 120 of the commoner species which are to be found above the 3,000 foot contour, whilst numerous related species are briefly referred to in the appropriate places in the text. The book is simply and ably written for the non-botanical reader and such technical terms as are introduced are fully explained. These explanations are also collected together into a glossary at the end of the book for easy reference.

Descriptions of the different species are serially numbered and arranged under families according to current botanical classification. However, Dr. Bond has included a simple guide, based on flower colour, at the beginning of the book, which makes identification an easy and straightforward matter for the non-botanist. Using this guide it is unlikely that the reader will need to refer to more than two or three specific descriptions at most before being certain of the name of any common flower. Many flowers are, of course, sufficiently distinctive to require only one entry in the guide.

The excellent illustrations, nearly all full page, are the joint work of Dr. and Mrs. Bond. It is to be regretted that in a few cases, owing to the quality of the paper, the reproduction does not do full justice to the finer details of the original drawing. Another point of criticism regarding the make-up of the book is that the title is merely printed on a piece of paper stuck on the spine.

"Wild Flowers of the Ceylon Hills", as the only popular book so far published on Ceylon wild flowers, and it should prove of great value to all up-country residents and visitors to the Ceylon hill districts.

G. B. P.

MINUTES OF THE MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT 2-30 P.M. ON FRIDAY, 21ST NOVEMBER, 1952, AT THE PLANTERS' ASSOCIATION OF CEYLON, 113, STEUART PLACE, COLPETTY, COLOMBO

Present :—Mr. R. C. Scott, C.B.E., (Chairman), Dr. A. W. R. Joachim, M.B.E., (Director of Agriculture), Mr. W. H. Gourlay (Chairman, Planters' Association Agency Section), Mr. W. R. Van der Kiste (Chairman, Planters' Association of Ceylon), Messrs. H. S. Hurst, A. J. Dickson, D. E. Hettiarachchi, Errol Jayawickreme, A. D. McLeod, G. K. Newton and J. Lamb (Director and Secretary).

1. Notice convening the meeting was read.

The Chairman announced that Messrs. V. G. W. Ratnayake, M.P., G. J. Harris and W. Neal de Alwis, M.P., had intimated their inability to be present at the meeting.

2. The minutes of the meeting of the Board held on 18th July, 1952, were confirmed without comment.

3. **Membership of the Board and Committees**

(a) **Board**

The Chairman reported that :—

(*i*) He had returned from long leave and resumed the Chairmanship of the Board as from 20th November, 1952. Mr. R. J. S. Bean, who had been nominated in his place, had therefore been relieved from the above date. He expressed his thanks to Mr. H. S. Hurst for acting as Chairman of the Board during his absence.

(*ii*) Mr. A. D. McLeod had also resumed his seat on the Board on his return from leave as from 23rd October, 1952. He had relieved Mr. L. F. J. Smith who had acted for him.

He welcomed Mr. McLeod back to the Board and thanked Messrs. R. J. S. Bean and L. F. J. Smith for their services as acting members of the Board.

(b) **Finance Sub-Committee**

The Chairman reported that a seat was vacant on the above Committee as a result of Mr. W. H. Attfield's resignation. He proposed the name of Mr. A. D. McLeod and stated that the Committee had recommended the nomination on account of Mr. McLeod's specialised knowledge of accountancy. Agreed.

4. Finance

(a) Audited Accounts of the Institute for 1951 and the Auditor's Report

The Chairman said that copies of the accounts and report had been issued to members under cover of Circular No. A 15/52 of 8th November, 1952.

He stated that the Finance Sub-Committee had that morning considered the Auditor's Report and Audited accounts very thoroughly.

Mr. A. D. McLeod proposed and Mr. G. K. Newton seconded the acceptance of the Audited accounts of the Institute for 1951 and the Auditor's Report thereon.

(b) Institute's Accounts for period ending 30th September, 1951

(1) The Chairman reported that copies of the above accounts had been circulated to members.

The Director stated that the cess was coming in satisfactorily and that to the end of October it had exceeded the figure for last year. There was, however, a big drop in the receipts for the month of October.

In reply to a question from Mr. A. D. McLeod, the Director said that the Norris Memorial Hall was completed but that the formal opening had been postponed.

5. Staff

The Chairman reported that :—

(a) Agricultural Chemist

Dr Haworth who had joined the Institute's staff on 1st August, 1950, and had resigned his appointment as reported at the last meeting, left Ceylon on 6th November 1952.

Applications from ten candidates had been received for the post of Agricultural Chemist. The Appointments Sub-Committee had on the Director's recommendation approved that Mr. D. H. Parish, B.Sc. Hons., Leeds University, at present Assistant Lecturer in Agriculture, Queen's University, Belfast, and Mr. J. A. H. Tolhurst, B.Sc., Agric. with Hons. in Agricultural Chemistry, Reading University, age 30 years, presently employed as Scientific Officer at Long Ashton Research Station, be short-listed. The Committee had also approved that Dr. F. R. Tubbs should interview these two gentlemen.

(b) Mycologist — Mr. B. N. Webster

The Chairman reported that Mr. Webster's agreement was signed at St. Coombs on the 18th October, 1952. Messrs. H. S. Hurst and G. K. Newton had signed on behalf of the Board.

(c) Engineer — Mr. J. Landreth

The Chairman said that members of the Board had already unanimously approved the Director's recommendation set out in Circular No. A. 12/52 of 23rd September, 1952, that Mr. Landreth should proceed on leave in order to have a holiday which he badly needed and also to be able to take his wife to the United Kingdom for urgent medical attention.

The Chairman said that the Board had also agreed to the appointment of Mr. B. D. Garnier to act for Mr. Landreth during his absence.

(d) **Superintendent, St. Coombs Estate — Mr. F. C. Daniel**

The Chairman informed members that information had been received that the Ceylon Association in London had approved in principle the proposals regarding the appointment of a Superintendent for St. Coombs when Mr. Daniel retired.

6. **Minutes of the 81st Meeting of the Estate and Experimental Sub-Committee**

The Chairman said that copies of these minutes had been issued to members under cover of Circular No. A. 17/52 of 17–11–52.

Members would have noted that the Visiting Agent's report dated 6th August, 1952, copies of which were issued to members under cover of Circular A. 10/52 dated 19th August, 1952, was discussed by the Committee at the meeting.

The Committee had also recommended the approval of the following additional votes on 1952 account :—

(*i*) Rs. 8,000 for maintenance of cart road
(*ii*) Rs. 5,000 for re-roofing lines } Approved

Members would have also noted that the Committee had recommended the inclusion of several items in next year's estimates. These would accordingly be incorporated in the estimates which would come up for consideration at the next Board meeting.

The Committee also recommended that the next Conference be held at the Regal Theatre, Nuwara Eliya, on Friday, 6th March, 1953. The theme suggested for the Conference was ' General Agricultural Problems." Agreed.

7. **Small Holdings Advisory Service**

The Chairman reported that the minutes of the meeting of the Small Holdings Sub-Committee which was held on 1st September, 1952, had been issued to members under cover of Circular No. A. 14/52 of 4th October, 1952.

The Director said that a full discussion on Small Holdings had taken place and he had prepared a report on the subject of aid to small holders. Government had since taken the matter up and further developments are awaited.

Electric Supply

The Chairman reported that as decided at the last Board meeting work in connection with the linking up of St. Coombs to the Government Electric supply had been put in hand and it was likely that the scheme would come into operation within a month's time.

It is now proposed to complete the whole scheme at one time instead of in stages as originally proposed. The complete work is estimated to cost approximately Rs. 93,000/–.

One of the three Tangye engines was sold for Rs. 7,600/–. He said that the Finance Sub-Committee had, after considering the matter, agreed to recommend the approval of the Director's proposal to have the whole scheme completed at one time. He informed members that the agreement between the Government and the Institute was to be signed at the Chief Engineer's Office on Saturday, 22nd November, 1952. Messrs. G. K. Newton and A. D. McLeod had agreed to sign on behalf of the Board.

Mr. H. S. Hurst proposed and Mr. Errol Jayawickreme seconded a proposal that the Board agree to the signing of the agreement and the use of the Board's seal thereon. Unanimously approved.

9. **Any Other Business**

(a) **Passara Sub-Station**

The Chairman reported that Mr. G. D. Austin, Assistant Pathologist, had returned to Passara at the beginning of November after an absence of six months at Hapugastenne, Ratnapura, where he had carried out experiments on shot-hole borer and Rhizoctonia. These experiments were carried out on both Hapugastenne and Galbodde estates with the co-operation of Mssers. James Finlay & Company.

(b) **St. Coombs Co-operative Stores**

The Chairman reported that the building in which this store was housed was completely gutted by fire on the morning of 28th July, 1952. All goods together with those books of the Society which were stored in the building were destroyed. The fire is believed to have been due to a short circuit in the electric wiring.

He asked for the Board's approval to have the building replaced.
Approved.

(c) **Annual Report of the Board for 1951**

The Chairman reported that the draft of the annual report of the Board for 1951 had been approved by all members.

(d) **Visit by the Minister of Agriculture & Food**

The Chairman reported that as notified to members by Circular No. A. 13/52 of 23rd September, the proposed visit to the Institute by the Minister of Food and Agriculture, Sir Oliver Goonetilleke, did not take place.

The meeting terminated with a vote of thanks to the Chair.

(Sgd.) J. LAMB,
Secretary.

Tea Research Institute of Ceylon.
St. Coombs,
Talawakelle.

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